APR - 7 1933

VOLUME XXVIII No. 181

JOURNAL
OF THE
AMERICAN STATISTICAL ASSOCIATION

MARCH, 1933

CONTENTS

STATISTICS IN THE SERVICE OF ECONOMICS. By Irving Fisher 1

ANALYSIS OF VARIANCE AS AN EFFECTIVE METHOD OF HANDLING THE TIME ELEMENT IN CERTAIN ECONOMIC STATISTICS. By Theodore W. Schultz and George W. Snedecor..... 14

CONSTRUCTION STATISTICS. By Corrington Gill..... 31

SCALES FOR MEASURING THE STANDARD OF LIVING. By Evelyn G. Tough and E. L. Kirkpatrick..... 55

THE STANDARD ERROR OF THE COEFFICIENT OF ELASTICITY OF DEMAND. By Henry Schultz..... 64

THE STANDARD DEVIATION AS A MEASURE OF THE INTENSITY OF SEASONAL ADJUSTMENT. By R. von Huhn..... 70

NOTES:

Business Curve Based on Interest Rates and Prices. By O. M. Smart 76

The Richards-Roope Tangent Meter (82); Economic Change and Financial Readjustment (82); The Cost of Government in the United States and Its Measurement (87); Progress of the Census (91); Miscellaneous Notes (93); Members Added (101).

REVIEWS..... 103

PUBLISHED QUARTERLY BY THE
AMERICAN STATISTICAL ASSOCIATION
PUBLICATION OFFICE: Rumford Press, Concord, N. H.
EDITORIAL OFFICE: Columbia University, New York City

Price $1.50 per copy $6.00 per annum

NO. 181 (VOL. XXVIII) MARCH, 1933

JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

Formerly the Quarterly Publication of the American Statistical Association

CONTENTS

STATISTICS IN THE SERVICE OF ECONOMICS. By IRVING FISHER 1

ANALYSIS OF VARIANCE AS AN EFFECTIVE METHOD OF HANDLING THE TIME ELEMENT IN CERTAIN ECONOMIC STATISTICS. By THEODORE W. SCHULTZ and GEORGE W. SNEDECOR..... 14

CONSTRUCTION STATISTICS. By CORRINGTON GILL..... 31

SCALES FOR MEASURING THE STANDARD OF LIVING. By EVELYN G. TOUGH and E. L. KIRKPATRICK..... 55

THE STANDARD ERROR OF THE COEFFICIENT OF ELASTICITY OF DEMAND. By HENRY SCHULTZ..... 64

THE STANDARD DEVIATION AS A MEASURE OF THE INTENSITY OF SEASONAL ADJUSTMENT. By R. VON HUHN..... 70

NOTES:

BUSINESS CURVE BASED ON INTEREST RATES AND PRICES. By O. M. SMART 76

THE RICHARDS-ROOPE TANGENT METER (82); ECONOMIC CHANGE AND FINANCIAL READJUSTMENT (82); THE COST OF GOVERNMENT IN THE UNITED STATES AND ITS MEASUREMENT (87); PROGRESS OF THE CENSUS (91); MISCELLANEOUS NOTES (93); MEMBERS ADDED (101).

REVIEWS: Mills: *Economic Tendencies: Aspects of Pre-War and Post-War Changes*, by G. E. Barnett (103); Taussig and Joslyn: *American Business Leaders*, by R. M. MacIver (104); Fledderus (Editor): *International Unemployment*, by D. Yoder (106); Timoshenko: *Agricultural Russia and the Wheat Problem*, by C. B. Hoover (109); National Industrial Conference Board: *The Fiscal Problem in Massachusetts*, by H. L. Lutz (110); League of Nations: *Balances of Payments, 1930*, by R. O. Hall (111); National Industrial Conference Board: *The Banking Situation in the United States*, by J. W. Angell (113); v. Schelling: *Die Wirtschaftlichen Zeitreihen als Problem der Korrelationsrechnung*, by V. P. Timoshenko (114); League of Nations: *Review of World Production, 1925–1931*, by A. Joy (115); Hunter and Phillips: *Disability Benefits in Life Insurance Policies*, by R. H. Blanchard (116); Myers: *The New York Money Market*, by H. D. Gideonse (116); Rodkey: *Preferred Stocks as Long-Term Investments*, by G. H. Evans, Jr. (117); Raver: *Recent Technological Changes and the Municipally Owned Power Plant*, by L. H. Seltzer (119).

Published quarterly by the American Statistical Association
RUMFORD PRESS BUILDING, CONCORD, N. H.
Editorial Office, Columbia University, New York City
Entered at the post-office, Concord, N. H., as second-class mail matter
Acceptance for mailing at the special rate of postage provided for in Section No. 1103. Act of October 3, 1917, authorised April 29, 1922

Officers of the American Statistical Association

ORGANIZED NOVEMBER 27, 1839

PRESIDENT	Stuart A. Rice	
DIRECTORS	Donald R. Belcher	Malcolm C. Rorty
	Robert E. Chaddock	Carl Snyder
	Louis I. Dublin	Edgar Sydenstricker
VICE-PRESIDENTS	Melvin T. Copeland	Arthur H. Richardson
	Frederick C. Mills	George B. Roberts
	Horatio M. Pollock	Henry Schultz
	Lowell J. Reed	William M. Steuart
SECRETARY-TREASURER	Willford I. King	
	Room 530, Commerce Building, New York University	
	236 Wooster Street, New York City	

CHAPTER AND DISTRICT SECRETARY

ALBANY CHAPTER
David M. Schneider, *New York State Department of Social Welfare, Albany, New York*

AUSTIN (TEXAS) CHAPTER
Carroll D. Simmons, *University of Texas, Austin, Texas*

BOSTON CHAPTER
Roswell F. Phelps, *Massachusetts Department of Labor and Industries, Boston, Massachusetts*

CHICAGO CHAPTER
Mrs. Bernice Lamb, *Federal Reserve Bank of Chicago, Chicago, Illinois*

CLEVELAND CHAPTER
Edward A. Stephen, *Bell Telephone Company, Cleveland, Ohio*

COLUMBUS (OHIO) CHAPTER
Howard H. Bronsman, *Bureau of Business Research, Ohio State University, Columbus, Ohio*

LOS ANGELES CHAPTER
J. L. Nicely, *Room 400, Union Oil Building, Seventh and Hope Streets, Los Angeles, California*

PITTSBURGH CHAPTER
George A. Doyle, *Bell Telephone Company, Pittsburgh, Pennsylvania*

SAN FRANCISCO CHAPTER
Robert W. Bachelor, *Federal Reserve Bank, San Francisco, California*

AREA REPRESENTED AND DISTRICT SECRETARY

DETROIT AND VICINITY
John W. Scoville, *Chrysler Corporation, Detroit, Michigan*

NEW HAVEN AND VICINITY
Chester H. Whelden, Jr., *Yale University, New Haven, Connecticut*

WASHINGTON AND VICINITY
Thomas B. Rhodes, *Federal Reserve Board, Washington, D. C.*

EDITOR	Frank Alexander Ross	
	405 Fayerweather Hall, Columbia University, New York City	
REVIEW EDITOR	Leo Wolman	
	30 Fifth Avenue, New York City	
ASSOCIATE EDITORS	Edmund E. Day	Edgar Sydenstricker
	Wesley C. Mitchell	Walter F. Willcox

NO. 181 (VOL. XXVIII) MARCH, 1933

JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

STATISTICS IN THE SERVICE OF ECONOMICS[1]

By Irving Fisher, *Yale University*

It has long seemed to me that students of the social sciences, especially sociology and economics, have spent too much time in discussing what they call methodology. I have usually felt that the man who essays to tell the rest of us how to solve knotty problems would be more convincing if first he proved out his alleged method by solving a few himself. Apparently those would-be authorities who are forever telling others how to get results do not get any important results themselves.

I well remember, nearly forty years ago, hearing a newly fledged professor of sociology deliver a learned lecture on methodology in sociology full of big words if not of big ideas. But he never, as long as he lived, contributed anything more than advising others how to do it. So far as I know, no one was ever materially helped by his advice.

And now here I am myself adding my own quota to the literature, already so big and so largely useless, on this perennially fascinating, if somewhat unprofitable, subject of method. In excuse I may say that this is only my second offense, the first being twenty-six years ago, and that I have hitherto, for the most part, tried to mind my own business and to saw my own wood instead of instructing others how to saw theirs. But I think my real reason for now and here breaking out on methodology is simply that it seems a suitable subject for me to choose in representing tonight both the Statistical Association and the Econometric Society, the oldest and the youngest of the scientific bodies devoted to the study of economic and social problems.

May I begin by saying that I am chiefly interested in both those societies as an economist, and I shall, accordingly, confine myself to the subject of statistics in the service of economics and only to one part of that vast subject, namely economic theory.

[1] Presidential Address delivered at the Ninety-fourth Annual Meeting of the American Statistical Association, Cincinnati, Ohio, December 29, 1932.

When, forty-two years ago, I wrote my doctor's thesis on certain mathematical investigations in the theory of value and prices, I was a student of mathematical physics and, with youthful enthusiasm, dreamed dreams of seeing economics, or one branch of it, grow into a true science by the same methods which had long since built up physics into a true and majestic science.

Of course, I was not the first to have such dreams for economics as a science. Cournot, Jevons, Walras, Pareto, Marshall, Edgeworth, Wicksell, and several others had dreamed those dreams before me. But some of these had too often found that the market for their wares was small and discouraging. The book which first fired my youthful enthusiasm was that of Auspitz and Lieben, Austrian bankers who, like another banker before them, Ricardo, wrote a highly theoretical treatise. But I found, when I visited Lieben in Vienna in 1893 that the readers of their *Investigations on the Theory of Value and Prices* had been very few. I know of no American economist except myself who has even read this notable book.

A year later, in 1894, I heard Edgeworth read a paper in the field of mathematical economics before the British Association for the Advancement of Science, and heard the, to me, unjustified criticism of it by Sidgwick, representing the typical economist of that time. It was with distress that I heard Edgeworth say he felt "damped" by hearing Sidgwick deplore the introduction into economics of such heretical methods as mathematics.

Even Cournot in those days was almost unknown among economists and had only barely been rescued from oblivion by Jevons and Marshall. Like the now famous Mendel in biology, Cournot in economics is an example of a scientist little appreciated until after he had died, and his work had, for a time, been forgotten.

A little later I again found that a contemporary of Cournot's, John Rae, had produced what I regarded then, and regard now, as a work of genius, deserving to rank, as to scientific method and results, far ahead of the *Wealth of Nations*, of which it was, in part, a criticism. Rae's work was not mathematical. It is easy reading and fascinating to those who read it. With Professor W. G. Mixter, who "discovered" Rae's neglected work and recognized him as a "fore-runner of Böhm-Bawerk," I did my best to help resurrect Rae's book, originally called *New Principles of Political Economy*. Later this was reprinted, rearranged and annotated by Professor Mixter under the title, *Sociological Theory of Capital*. I also dedicated my own books on Interest to Rae. But even now Rae's great book has not fully come to life. Rae not only exemplified what seems to me a correct *method* but he correctly

described a scientific methodology and contrasted his method with the unscientific method of Adam Smith.

Since there are no mathematical symbols in Rae's book, its failure to receive the prompt and full recognition it deserved must be due to something else than mathematics. It may have been in part his very methodology, which I so much admire but which at that time had no audience ready to appreciate it.

The difficulties encountered in getting most professed economists to adopt the methods of physical science made me nearly despair of ever living to see economics become a science in the sense that physics is a science.

A young economist in a western university, who sees eye to eye with me as to methodology, shocked and pained me about twenty years ago when he told me that his own enthusiasm had been so damped that he had practically given up his original life ambition of getting recognition for his contributions toward making economics into a true and useful science. But he was too easily discouraged. For even at that time, those of us who had still earlier entered economics from the approach of the natural sciences, as contrasted with the approach from philosophy or history, had already noticed a great change.

And today we suddenly wake up to realize that the methods which have made physics a science have at last taken a vigorous hold on the rising generation of economists. To illustrate, I need only mention, among many others, Frisch, Divisia, Rueff, Schumpeter, Keynes, Bowley, Amoroso, Gini, Haberler, Leontief, Zawadski, Kondratieff, Hotelling, Moore, Schultz, Roos, Evans, Crum, Ezekiel, Rogers.

Moreover, the establishment of the international Econometric Society two years ago, the meetings it has since held in Europe and America, and its journal *Econometrica* beginning next month, signalize this new birth of the scientific spirit in economics.

But what is the essence of the scientific method which these young economists have at heart? I shall try to interpret it. And I would also refer you to the interpretation of Schumpeter in a brilliant article to appear in the first number of *Econometrica*.

As I understand it, this new outburst of the scientific spirit is not a new "school" but simply an adaptation to economics of methods already nobly tested in the natural sciences. I hope it may mark the beginning of the end of "schools" in the sense of partisan groups or cults. The modern economist occupies a position midway between what used to be called the Austrian school and the Historical school. The Austrian school contributed, or shared with Von Thünen and Gossen in Germany, Jevons in England, Walras in Switzerland, and J. B.

Clark in America, the honor of contributing the fundamental idea of "grenz nutzen," or "marginal utility" as it has usually been called in English, or "final degree of utility" as it was called by Jevons, an idea corresponding closely to differential quotients as used in mathematics and mathematical physics.

Nevertheless, the first enthusiasm over the Austrian school's concept of marginal utility and its application was followed by disappointment. The Austrian school seemed to yield no second crop comparable with the first. One would-be facetious critic wrote an article on "the final futility of final utility."

Professor (afterward President) Hadley voiced this disappointment when he said:

> We are teaching more about the theory of utility than did our fathers; but are we doing so much for the realization of that theory in the organized life of the nation? If we fail in our influence upon public life, we fail in what is the most important application of our studies, and in what may almost be said to constitute their fundamental reason for existence. . . .
>
> The older political economy expressed its results in pounds, shillings and pence. They might be true or they might be false, but they were at any rate in a form where they were capable of measurement and verification. . . .
>
> The new political economy has substituted a more vague conception of wealth for the more concrete one, and many of its propositions have suffered a corresponding loss of clearness and precision. The mercantile school of economists had measured wealth in terms of money. The first generation of their critics measured it in terms of food; the second and third generations measured it as "commodities"; our own generation measures it in terms of utility. But food is a less definite and tangible measure than money; commodities are a less definite and tangible measure than food; and utility is perhaps the least definite and tangible measure of all. . . .
>
> I am disposed to think seriously that the excessive use of psychological terms and conceptions, to the neglect of purely commercial ones, has been the most potent cause to weaken the influence of economists among statesmen and men of the world.

President Hadley was right. The Austrian School, though marginal utility was a real contribution, obviously lacked a full contact with reality.

And yet the German Historical School, though it stressed realities, was even more disappointing. Starting off with a commendable reverence for facts, just as does the physicist, they mistook their compilations for "induction" in economics. They got nowhere. Their ponderous volumes contained vast collections of historical facts and statistics but there was little or no connecting framework of principle.

Both the Austrian deductive school and the German historical school have now ceased to command much enthusiasm; for some time the

effort has been to find a satisfactory way to join together theoretical and historical studies. This effort has found expression through mathematics and statistics and mathematical statistics—the mathematics to express theory and the statistics to express historical facts.

The Econometric Society, as stated in its constitution, stands for the "advancement of economic theory in its relation to statistics and mathematics." No one today needs to apologize for, or even defend, either statistics or mathematics as legitimate and helpful instruments in the service of economics. Both are found abundantly in any modern economic journal. The Statistical Association now has an entire journal devoted to mathematical statistics. Any modern text book of advanced economics will usually contain tables and charts of statistics, diagrams of supply and demand and some mathematical formulae, if only in the appendices.

This has all come about so gradually that any one who will take the trouble to compare modern economic literature with that of one and two generations ago, even by turning a few of the pages at random, and looking for diagrams and formulae, will be startled at the contrasts. Ricardo in his *Principles* made no use of mathematical symbols or of statistics. Even when I was a student, the leading economic work of the time, the *Advanced Course*, as Francis Walker's text book was called, contained no statistics or mathematics. In my doctor's thesis in 1891, I devoted several pages to defending the use of mathematics in economics against the objections then alleged against it.

Yet mathematical method merely consists in the use of symbols as short hand expressions of measurable magnitudes, and statistical method merely "consists in the study of social phenomena which can be counted." Thus they are conveniences rather than necessities.

That is, while statistics and mathematics are, or can be made, helpful in joining theory and fact into a true economic science, they are incidents rather than indispensable instruments for that purpose.

Scientific economics will naturally make liberal use of mathematics and statistics. But the essential of scientific method is not a matter of form but of substance. The first essential, in my opinion, is to recognize the absolute distinction between scientific and historical truth, that is between principles and phenomena. My impression is that few, if any, economic students ever grasp this fundamental distinction who have not had some considerable training in the physical sciences. A scientific truth is in the conditional form: "*if A is true, then B is true*"; while an historical fact is in the unconditional form: "*A is true*" or "*B is true.*" If this distinction were clearly grasped by every student who wishes to understand and discover sound economic principles, economics

would, I believe, develop into a true science very speedily. Until the great majority of our students do grasp this distinction, much of economic writing will be pseudo-science—either of the type of half-baked economic theory or of half-baked economic history.

As I said in 1906, when chairman of the economic section of the American Association for the Advancement of Science:

> Those who maintain that economics is not and never can be a true science base their contention on the fact that social phenomena are not constant, like, they say, the phenomena of astronomy or physics, but differ widely at different times and under different circumstances. They point out that the determination of prices under modern free competition is quite different from their determination under the mediaeval system of custom and status; that the remuneration of labor depends on what are the historical and legal institutions with respect to slavery, labor legislation, etc.; that the economic phenomena of to-day are not comparable with those of the times of the Greeks and Romans, nor are the phenomena in America comparable with those in Russia.
>
> To one who is familiar with the spirit of science, however, these variations, so far from being objections, are really confirmations of the theory that economics is a science. For in all science it is fundamentally true that phenomena will "differ according to circumstances," and the office of the scientist is simply and solely to find out under what circumstances one set of phenomena will occur, and under what circumstances another set will occur. We could hardly claim that hydrostatics is not a science for the reason that, in a mountain lake, water is found to be stationary and at a level, whereas at Niagara it is found to be in motion and passing from one level to another; that, whereas the water in a mill-race passes in a downward direction, the water which we draw in our houses moves through the pipes upward; that whereas, by means of a syphon, water may be induced to flow out of a receptacle, it will, in an ordinary tub, remain inert. The whole science of hydro-statics has developed as a consequence of the persistent effort to unravel these puzzles, and today we know not only that under different circumstances water will act in different ways, but we can formulate what are the precise conditions under which it will act in each separate manner.
>
> In economic study we should in like manner apply ourselves to discover what conditions make the difference in the phenomena between modern and ancient or eastern and western civilizations, rather than content ourselves with the truism that they do differ. Much of the field has in fact already been covered. It is known, for instance, that under conditions of free contract and competition, the price of an article will be determined by the intersection of its supply and demand curves, and that, on the other hand, if the régime be one of monopoly, the price will be determined on the principle of "what the traffic will bear," in the manner so admirably shown by Cournot. In these cases the results are not absolute and unconditional, but depend on specified hypotheses. In this respect they are exactly similar to any other scientific result.
>
> If economics is a science, its truths must be conditional. Thus, the incidence of a tax on ground rent will lower the value of land, provided there are no counteracting causes. This does not assert that actually, after such a tax, the value of the land will fall; for in the meantime some opposing cause may have intervened, such as the discovery of an oil-well. Again, an increase of the quantity of circulating medium will raise prices proportionately, provided the velocity of

circulation and the volume of business transactions remain the same. This "quantity theory" does not assert that prices do rise after every increase in the quantity of money, and those who thus interpret it are guilty of the confusion already noted between conditional and unconditional truth—in other words, between a scientific law and an historical fact.

True science does not consist in the mere grouping of historical phenomena. In fact, Bacon makes a distinction between what he calls the popular and the inductive method, or what may be preferably called, following the example of John Rae, the systematic and the scientific. The two are commonly confused, but are entirely distinct. "System" consists in classifying phenomena; "science" consists in discovering the laws to which they conform. System explains phenomena by means of what is common and familiar; science explains them by what is simple, however recondite. System is exemplified in such descriptive studies as grammar, descriptive geography and history; science is exemplified by such analytical studies as mathematics, physics, and latterly, biology. The classifier or system-maker is content with generalization of facts. These express the usual order of events: for instance, that the sun rises once a day. They do not express the reason or principle.

Many studies which are now scientific had their origin in what was originally systematic. The predecessors of the modern physicists classified bodies into "light" and "heavy." Iron, they maintained, is heavy and therefore falls; fire is not heavy, and therefore rises. How different is this obsolete method of treating the subject from our modern analytic notion of gravity, or rate of increase of velocity, by means of which are explained both the falling of iron and the rising of "fire"!

Similarly, the prototype of biology was "natural history," and consisted chiefly in the mere classification of animals and plants into species, genera, etc. Modern biology has supplanted such elaborate classification by introducing, through Darwin, the analytical ideas of heredity, variation and selection, and in this way the descriptive study of natural history has been converted into the true science of biology.

And Mendel's laws have added insight to Darwin's and given us absolute mathematical conclusions in terms of probabilities and, in some cases, of certainties. We know if two blue eyed persons marry all their children will have blue eyes. If A is true, then B is true.

The same evolution which has been outlined in physical and biological science is doubtless taking place in economic science. Yet it must be confessed that few have yet mastered the distinction between a general fact and a scientific law. When we hear it stated as fundamental in political economy that skilled labor is better paid than unskilled, it is clear that this is merely a general rule and not a necessary law. The single fact that certain seamstresses, though skilled, are ill-paid, is sufficient to disprove the statement as a necessary law, though it does not affect it as a general fact.

The historical school justly complains of the superficial character of the theories which have been sometimes offered. This objection holds, however, not against theory as such, but against false theories; and herein lies the virtue of Bacon's method. The inductive method, by which any theory of phenomena must be checked by reference to actual historical fact, thus forms the means of distinguishing between truth and falsity. Rejecting false theories is quite different from

rejecting all theories. What is needed now in political economy is to rid ourselves of the false and superficial theories, on the one hand, which have been constructed, *a priori* and irrespective of facts; and, on the other hand, to release ourselves from the cheap empiricism of the historical school, who interpret their task as merely one of generalizing phenomena without analyzing them.

Science is one. The logic for economic science should be the logic for all science —a combination of induction and deduction. Facts are at once the test and the material of science; but laws are its ultimate goal. Laws are not facts, but the relations between facts. Newton's first law of motion, that a body tends to move uniformly in a straight line, is not a fact, nor is it a general expression of facts. Probably no particle in the universe has ever moved exactly in a straight line or with uniform velocity for so much as a single second. Yet it would be an error to conclude that Newton's law is unreal and untrue in actual nature. The law has an "if" in it—"if a body were acted on by no force, or by perfectly balanced forces, its motion would be uniform in both rate and direction." Withdrawn thus from actual events, Newton's law seems to the non-scientific mind to lose all objective truth. This again is an error. Newton's law is absolutely true to nature. The fact that it is conditional does not make it arbitrary. We are not free to replace it by the mediaeval opinion, viz., "If a body is let alone it will gradually spend its force and slacken its speed." This formulation, unlike Newton's law, would not stand the test of facts. A valid law is true at all times and places, in the sense that, should the particular conditions arise, the prescribed result would follow, but not in the sense that the particular conditions must needs ever arise.

It is sometimes said that the ability to predict is the final test of science. But it is not a test of science only. Successful prediction requires two conditions: one is a knowledge of science—of what will happen under given circumstances; and the other, equally essential, is a knowledge of history—of the particular circumstances of the present moment, out of which the future, to be predicted, will grow. Failures of prediction are due to the lack of either of these two essential conditions.

An example of a failure of prediction due to imperfect knowledge of facts is found in the case of the closure of the Indian mints to silver in 1893. It was expected that the value of the silver rupee would be maintained at 16 pence. But no account was taken of the large coined hoards of silver among the natives. After these had been put into circulation the price of the rupee did eventually rise to 16 pence and has remained there. In this case the failure of prediction at first was due, not to any defect in monetary science, but to ignorance of Indian history.

Usually, however, failures in economic prediction are due to the lack of scientific rather than of historical knowledge. In the Civil War, when there was a premium on gold, the scientific explanation of which was really simple, the public attributed the premium to the machinations of speculators. Accordingly, Congress was induced to close the Gold Exchange; whereupon, to the consternation of the framers of this foolish prohibition, the premium on gold soared higher than ever. The result was a hasty and shamefaced repeal.

Experience of this kind is too common in economic legislation. It serves as a warning that we should know something of economic science before venturing to tamper with economic conditions. The men who need this warning most of all are those who despise all "theories" and call themselves "practical." It is they

who legislate a measure one day and have to repeal it the next. A truly practical man can predict how a measure will work, and his power so to do requires not only what is called "practical" but also what is called "theoretical" knowledge; a knowledge, in short, not only of history but of science.

Unfortunately as yet neither economic laws nor economic data are sufficiently known to enable economists to make safe predictions. In both respects it is still a backward science as compared with many others. A few months ago astronomers from California and Japan came to New England to observe a total eclipse of the sun. The eclipse came off on schedule time within a second or two—so nearly perfect is this superbly scientific science of astronomy. This was because these astronomers had both sorts of knowledge. They knew on the one hand that, under certain conditions, the moon would pass between the earth and the sun (that if A was true, then B would be true) and they knew, on the other hand, that those conditions, A, were fulfilled. Consequently they knew in advance what soon became a historical fact, that (unless something had been left out of their calculations) the eclipse must occur, and that B would be true.

Contrast this with our economic predictions. We are now going through an economic eclipse which began in September, 1929. But few if any economists predicted it, or, if so, they failed to make their predictions public. Economics will be more of a science when we can predict depressions.

Yet we have the comfort of knowing that there are physical sciences like meteorology which are not yet able to make very good predictions. While the astronomers could tell with precision and a century ahead of time when the moon would obscure the sun the meteorologist could not tell, even approximately and even a day ahead of time, whether or not some cloud would obscure both. So it turned out that while the Japanese coming to Maine saw the moon eclipse the sun, the Californians a few miles away only saw an unpredicted cloud eclipse the eclipse.

It was because practically all the would-be economic forecasters have for the last four years failed dismally to tell the business man what to expect that a business man, Mr. Alfred Cowles, III, has stepped forward to finance the Econometric Society in the hope that out of it might grow scientific prediction. He has also organized a statistical laboratory where he is trying to make use of the most promising methods. He has a paper to present here at a joint session of the Statistical Association and the Econometric Society on some of the failures of recent economic predictions.

It is well that we face these failures and that, when we fail, we confess

it with due humility. I confess it. It is true that in September, 1929, I publicly stated my belief that we were "then at the top of the stock market" and that there would be a recession, this forecast being largely on the strength of the elaborate correlation work of Karl Karsten. And this proved true. But unfortunately I also stated my belief that the recession would be slight and short; and this proved untrue. I can now see that my failure was due to insufficient knowledge of both kinds, scientific and historical. I did not then know certain scientific laws of depressions and I did not know, as well as I should, the historical background of conditions. For instance, I had counted on the continuance of the open market policy of Benjamin Strong of the Federal Reserve Bank of New York, not knowing that these had largely died with Governor Strong the year before. As to the laws governing depressions, I did not then know, what since I have learned and embodied in my book, *Booms and Depressions*, the important rôle of over-indebtedness and its tendency to break down the price level through distress selling, contraction of deposit currency, and slackening of its velocity. Had I had these two sorts of knowledge in 1929, even to the modest extent which I can now claim to have them, that is, if I had had more correct and complete historical information on the one hand, and more correct and complete knowledge of some of the scientific laws involved on the other, my failure to predict this economic eclipse would at least have been lessened. But even if we had had all the foresight which "hindsight" and scientific studies have since brought, we could still only have made a general and largely qualitative rather than a specific and really quantitative prediction. Moreover there are always unforeseen circumstances. Any prediction, even in astronomy, must always be subject to the reservation that "other things remain equal" or nearly so.

We economists can, I assume, never hope to rival astronomical predictions of eclipses. We shall be lucky if we can ever rival meteorological predictions of cloudiness. Yet there is no reason to despair of forecasting depressions—and quantitatively to some extent. The sessions of the Statistical Association this year are very largely devoted to studies of this depression problem. They should help lay a basis for further and progressively successful studies of the nature of depressions, which studies should ultimately bear fruit in successful forecasting. But such an outcome will not eventuate from such merely *a priori* studies as characterized the Austrian school, nor from such merely descriptive studies as characterized the historical school, nor even from the grinding out of correlation coefficients between statistical series whose inner relationships are unknown or possibly non-existent. Pure

empiricism will be as disappointing as all the other methodologies which we are quietly relegating to the scrap heap. We need a rational element along with the empirical.

Astronomers could never have predicted eclipses by means of correlation coefficients. Correlation coefficients are seldom used in astronomy although the statistical material available for such calculations is vastly greater than in economic science. The reason is that usually better and more fundamental relationships are available than the mere linear relationships obtainable by the correlation method. Such relationships are necessarily superficial, whether in astronomy or economics, and must ultimately give place to something less superficial. No astronomer would think of taking the raw statistical data which his telescope discloses, consisting of innumerable angular measurements, and simply throwing them into the hopper of a correlation machine. If he did, the hodge podge which would come out he would never dream of calling science. And I fear much of the economists' and statisticians' calculations with correlation coefficients will not get us very far. They may be a good stop-gap or make-shift while we are deciphering the true rational relationships.

The distinction between shallow statistical empiricism and a rational statistical analysis is well illustrated by contrasting the earlier treatment of workmen's budgets and the recent use of the same data by Ragnar Frisch, now editor of *Econometrica*.

The budget data of workmen used to be put merely in the form of percentages spent on food, clothing, rent, fuel, lighting, etc. The most interesting result was the so-called "Engel's law" that the bigger the income, the smaller percentage of it spent on food. The fact that economists had the temerity to call this empirical generalization a "law" is itself a reflection on economics as a science. A few of us have tried, on the other hand, to use these percentages together with data on the cost of living as a means of calculating statistically the demand curves and marginal utility curves which, according to economic theory, must underlie and determine the workman's choices of food, clothing and so on, resulting in the budgetary and price phenomena. Of two available methods of tracing our way back from the budgetary phenomena to the fundamental law of demand, that of Ragnar Frisch is the most practical. His actual statistical results are as yet preliminary and may well be found inaccurate. But as to method, his work is a model of what statistics should be in the service of economic science. Thus may we give a place, in statistics, even for such fundamental, though highly theoretical concepts as that of marginal utility. The shadowy ideas of the Austrian school can then be turned into statistical

results through a proper method. In this method certain equations of pure theory play a rôle; and, without these, the mere statistics will tell us next to nothing. Among these essential relations the simplest is the well known theorem that the marginal utility of, say, food is equal to the marginal utility of money multiplied by the price of food.

Only by such scientific methodology can the statistician get beneath the surface of such empiricism as an "Engel's law," down to a statistical evaluation of a demand or utility curve.

The early astronomers had their analogue of Engel's law. It was called Bode's law, expressing the relative successive distances of the planets from the sun. Today, no astronomer would think of Bode's so-called law as anything more than a rough description or empirical rule. It is not a law comparable with Newton's laws of motion or of gravitation or Kepler's laws of planetary motion.

We can never fulfil statistically those relations found in fundamental economic theory, if we make no use of those fundamental relations in our manipulation of the raw statistical data, any more than an astronomer could compute the orbit of a planet from the fullest data as to angular measurements afforded by his telescope, without using the relation that the planet is attracted by the sun inversely as the square of the distance. In both cases, theory and fact must go hand in hand. Otherwise the world of observation and statistical data will be almost meaningless for lack of any rational framework to fit into; and conversely our theory will be almost meaningless for lack of any statistical expression or verification. We should then have two separate realms of study—a barren set of statistical observations and a barren set of high-spun theories, corresponding to the historical and Austrian schools.

Six years ago Professor Wesley Clair Mitchell in his address as President of the American Economic Association spoke of the fact that a quantitative analysis was not only different from a theoretical analysis but was found to deal with a different set of concepts. Doubtless that is true—in economic statistics. But it ought not to be. As long as it is true we cannot boast of being very scientific.

Other illustrations could be given. The evaluation of the velocity of circulation of money is an example. We talk about it in our courses on economic theory, and used to say it could never be estimated. But it is possible to show that the total circulation of actual physical money in the course of a year is equal to the money deposited in the banks during the year plus the payrolls of the year, plus a number of other but insignificant items. This total circulation divided by the money in circulation is the velocity of circulation. And from this relationship, together with the requisite statistical data, we can derive, not by

empirical correlations but by virtue of the rational theory involved, the statistical result that the velocity of circulation of money in the United States is about twenty-five times a year.

Now that so many able young men, fresh from training in the methods of physical sciences and mathematics, are entering the field of economics and statistics we may expect a gradual disappearance of rank empiricism and arm chair theory alike and a progressive substitution of a rational scientific method for connecting fact and theory. We shall then know our phenomena—that A is true. We shall know, both by *a priori* reasoning and by *a posteriori* testing, our laws—that if A is true, then B must also be true. And finally, from these two sorts of knowledge—namely knowledge of the historical fact that A is true and knowledge of the scientific law that if A is true, then B is true—we can predict in advance that B will be true.

To many all this may seem something new in economics; but it is only an application of something very old in those sciences in whose footsteps we must follow if we are ever to take our place among them as should be our aim and our right.

And as economics does take its rightful place as a science with laws verified by facts and capable of predicting, in some degree, economists will have the satisfaction of feeling that sound economic theory has practical applications, that Hadley's criticisms have been met and that the business man and the statesmen are justified in seeking our advice as they seek advice in other fields of science.

Both of these groups of men of affairs are anxious to get quantitative knowledge, to be able to weigh and measure. They need econometrics. In its absence their accountants are fast developing their own methods with a theoretical basis of their own. Incidentally, one of our tasks, already undertaken by Professor Canning, is to connect these results of practical experience in accountancy with economic theory.

In short, what we need in economics, or that branch of economics which we now call economic theory, is more of the old, old method which made astronomy, physics, chemistry, and, recently, biology into true sciences. That goal, as I interpret the rising generation of students of "economic theory," is where they are tending. Moreover they know where they are going. And they are on their way.

ANALYSIS OF VARIANCE AS AN EFFECTIVE METHOD OF HANDLING THE TIME ELEMENT IN CERTAIN ECONOMIC STATISTICS [1]

By Theodore W. Schultz and George W. Snedecor, *Iowa State College*

During the course of an investigation into the geographical distribution of prices paid to producers of swine in Iowa, the usual problems arose concerning the seasonal and secular changes in time series. Some of these problems were solved in an unusually satisfactory manner by the use of the new technique developed by R. A. Fisher [2] and known as *analysis of variance.*

Analysis of variance [3] is not widely used to interpret economic statistics. The reasons are several. The method is new. The technique at first appears complex and students are not familiar with the basic principles underlying the procedure. Naturally, these operate against its application. Because of this it is thought desirable to take an actual problem in economics and indicate the steps that are involved in applying analysis of variance.

The data herein analyzed are the prices paid to producers collected by the Crop Reporting Board of the United States Department of Agriculture. In this monthly survey the price correspondent is asked to report the price of hogs per 100 pounds liveweight in his locality, as of the 15th of the month. The original data are tabulated on a county basis which is, therefore, the smallest geographical unit that can be considered. Each month from 150 to 200 price correspondents have sent to the Crop Reporting Board their estimates of hog prices in their community. These reports are fairly well distributed over the state. Whether or not these data are subject to any bias and their general adequacy, are discussed in considerable detail by Sarle in *Reliability and Adequacy of Farm-Price Data.*[4] Inasmuch as Iowa is strictly a surplus swine area with large numbers of hogs being sold throughout the entire season, the representativeness of these price reports may be accepted with a good deal of confidence.

For the purpose of this study the state was divided into four districts each representing about one-fourth of the area of Iowa. In making the division several factors were considered. For one, districts A and C,

[1] Journal Paper No. B74 of the Iowa Agricultural Experiment Station, Ames, Iowa.

[2] First published in 1923, R. A. Fisher and W. A. Mackenzie, "Studies in Crop Variation, II. The Manurial Response of Different Potato Varieties," *Journal of Agricultural Science*, Vol. 13.

[3] Variance is the square of the standard deviation.

[4] United States Department of Agriculture, Department Bulletin No. 1480. 1927

TABLE I

IOWA HOG PRICES RECEIVED BY PRODUCERS BY DISTRICTS AND BY MONTHS FOR 1930–31

(Dollars per 100 pounds)

(1) District	(2) Oct.	(3) Nov.	(4) Dec.	(5) Jan.	(6) Feb.	(7) Mar.	(8) Apr.	(9) May	(10) June	(11) July	(12) Aug.	(13) Sept.	(14) Sums	(15) Means	(16) Sums of squares*
(2) A	8.84	8.04	7.39	7.06	6.44	6.80	6.78	6.03	5.40	6.00	5.91	5.07	79.76	6.65	543.079
(3) B	8.83	8.23	7.31	7.10	6.62	6.87	6.86	6.10	5.39	5.85	5.66	5.20	80.02	6.67	547.189
(4) C	8.80	8.17	7.32	7.11	6.63	6.84	6.92	6.06	5.57	6.16	6.24	5.26	81.08	6.76	559.252
(5) D	8.86	8.45	7.34	7.17	6.65	6.88	6.92	6.30	5.60	5.24	6.36	5.38	82.15	6.85	574.011
(6) Sums	35.33	32.89	29.36	28.44	26.34	27.39	27.48	24.49	21.96	24.25	24.17	20.91	323.01	....	.....
(7) Means	8.83	8.22	7.34	7.11	6.58	6.85	6.87	6.12	5.49	6.06	6.04	5.23	.....	General Mean 6.73	.....
(8) Sums of squares	312.054	270.526	215.506	202.215	173.477	187.557	188.801	149.984	120.597	147.106	146.351	109.357	.....	....	2,223.531

* These sums of squares are calculated, in row 2 for example, as follows:

$$(8.84)^2+(8.04)^2 \ldots +(5.07)^2=543.079$$

which cover the western half of the state, have had blanket freight rates on hogs to Chicago, while the rates within districts B and D were decreasingly less in going from west to east. Then, too, northwest Iowa, district A, produces a heavy lard hog; this area has an abundance of corn, while northeast Iowa, district B, is partly dairying and hogs are not only lighter in weight but also are marketed earlier in the season. Farmers in districts C and D, the southern half of the state, have their sows farrow early. Again, the weight of the swine sold in C and D is considerably less than in A.

Each monthly district price in Table I is the arithmetic mean of the 30 to 50 reports obtained from the counties in that district. The larger the number of price reports appearing in the district-month prices, the greater their stability. This was clearly shown when the study was extended and the state divided into 12 instead of 4 districts. In fact, as the size of the district was decreased there developed an amount of instability greater than could be accounted for by random sampling. Apparently the reason for this lay in the character of the questionnaire which the reporter is requested to fill out. As already indicated, the price correspondent is asked to give the price in his locality of 100 pounds of hogs liveweight. Those familiar with the hog industry know that the actual prices paid for hogs, even in a surplus area like Iowa, cover a wide range, especially in the summer months when both prime hogs and old sows are sold in quantity. This factor could virtually be eliminated if the price correspondent were asked to quote the going price upon a specific grade of hog instead of upon hogs in general. It is by averaging a number of reports that a more representative figure is obtained.

It is apparent from Table I that the downward trend is the chief factor in the variation of these prices. Some variation from district to district occurs, and there is a noticeable irregularity in the manner in which the district prices respond to the general decline in hog prices. The latter, attributable to sampling errors, must be separated from the temporal and geographic variations in order that they may be used as a basis of tests of significance. It is for this purpose that the analysis of variance has been found highly satisfactory.

The necessary calculations are not onerous. The sums of the rows (column 14) add to \$323.01, a number which is verified by adding the sums of columns in row 6. In the same manner, the sums of squares of the prices in the several rows total 2223.531. The verification is easily obtained by adding the numbers in row 8.

A "correction term" is now computed thus:

$$\text{Correction term} = \frac{(323.01)^2}{48} = 2{,}173.655.$$

The divisor, 48, is the total number of district-month prices entering into the total, $323.01.

These are the data from which are calculated the sums of squares in column 3 of Table II. The procedure will now be explained.

TABLE II

ANALYSIS OF VARIANCE OF PRICES PAID TO PRODUCERS OF SWINE IN IOWA, 1930–31

(1) Source of variation	(2) Degrees of freedom	(3) Sums of squares	(4) Mean squares	(5) Standard deviation
Between means of districts	3	0.299	0.099	.....
Between means of months	11	49.205	4.473	.....
Sampling error	33	0.372	0.011	0.105
Total	47	49.876	.....	1.030

First. The total "sum of squares" in the last line of column 3 is

$$2{,}233.531 - 2{,}173.655 = 49.876.$$

This will be recognized as the sum of the squares of the deviations of the 48 prices from the general mean. The number subtracted from the sum of the squares of all the prices is the correction term computed above.

Second. The sum of squares "between means of districts" is

$$\frac{(79.76)^2 + (80.02)^2 + (81.08)^2 + (82.15)^2}{12} - 2{,}173.655 = 0.299.$$

The divisor is the number of prices entering into each of the sums whose squares are added in the numerator. This "sum of squares" is based on the sum of the squares of the deviations of the four district means from their mean, $6.73.

Third. The sum of squares "between means of months" is

$$\frac{(35.33)^2 + (32.89)^2 \ . \ . \ . \ + (20.91)^2}{4} - 2{,}173.655 = 49.205.$$

The divisor, 4, is again the number of prices entering into each of the sums.

Fourth. The sum of squares attributable to random sampling errors is the difference,

$$49.876 - (0.299 + 49.205) = 0.372.$$

The analysis thus far effected has reduced the total sum of squares to three portions having their sources in (i) actual price differences between districts, (ii) temporal price changes affecting all districts alike, and (iii) sampling errors. This fulfills the requirements set up by Mudgett [1] when he spoke before one of the annual meetings of this Association, "the solution must involve a decomposition of the series into various elements, some of which can be allocated as the effects of specific and important causal forces, and others of which will be classified as random elements in a stable universe."

In the sum of squares between means of months in Table II we have presumably isolated all of those price variations from the general mean which are due to general market forces. In like manner, in the sum of squares between means of districts, we have attempted to include only those price deviations due to the geographical situations of the districts. We assume that the market affected the price of hogs in the several districts simultaneously in the same direction and in like magnitude. It is this aspect of the time element which has been removed. In each of these groups there will always be included variations due to sampling error.

The mean squares in column 4 of Table II are the results of dividing the sums of squares by the corresponding degrees of freedom in column 2. The term "degrees of freedom" has proved puzzling to many readers of Fisher's works. In each line except that containing the sampling error, this number is merely one less than the corresponding number of items going to make up the sum of squares. Thus, in the last line, there are 48 district-month prices, yielding 47 degrees of freedom. This corresponds with "Student's" [2] modification of the standard deviation in which the sum of squares is divided by $n-1$ instead of by n. One way of rationalizing this is to recall that one statistic, the sum (or mean), has been computed from the 48 prices, necessitating a reduction in degrees of freedom from 48 to 47. Another way is to observe that 47 independent comparisons can be made between the prices and the sum (or mean), but that the 48th is then fixed—its value is merely the difference,

$$(\text{sum of 48 prices}) - (\text{sum of 47 prices}).$$

In the case of sampling error, the number of degrees of freedom is the product of those corresponding to district and month—

$$3 \text{ times } 11 = 33.$$

[1] Bruce D. Mudgett, "The Application of the Theory of Sampling to Successive Observations Not Independent of Each Other," *Proceedings of the American Statistical Association*, Vol. XXIV, p. 112.

[2] *Biometrika*, London, VI, pp. 1–25, 1908.

This may be explained by a reference to Table I. For each district a sum is computed, leaving only eleven degrees of freedom per district. But also, a sum of four district prices in each month is computed and used in the calculations, leaving only three independent district prices in each of the eleven independent monthly groups.

An essential and most convenient feature of this method of analysis of variance is the additive nature of both the degrees of freedom (column 2) and the sums of squares (column 3). The mean square due to sampling error is frequently referred to as the "interaction." In this sense, it measures the differential response of the several prices to (i) geographical location and (ii) trend in price level. In our problem, this lack of uniformity in response to general conditions is attributed to sampling error. This feature will be discussed more at length later.

The mean squares in column 4 must be given particular attention—they, in fact, constitute the analysis desired. If the entire series of 48 district-month prices had been drawn at random from a homogeneous normal population, these mean squares would differ only by the small amounts due to random variation, and each one would be an unbiased and independent estimate of the variance in the population. In our example, this is not the case. Only the mean square attributed to sampling error furnishes such an estimate. The others, being so different from this, indicate heterogeneity in the population sampled. Both geographic location and changes in prices during time have introduced variability. These sources of variation have now been effectively isolated from the sampling error.

The standard deviation of the 48 district-month prices before isolating the heterogeneity due to temporal changes and to variation between districts was,

$$\sqrt{\frac{49.876}{47}} = \$1.030 \text{ per 100 lbs. liveweight.}$$

After elimination of known sources of variation, the standard deviation attributed to sampling error is

$$\sqrt{0.011} = \$0.105 \text{ per 100 lbs. liveweight.}$$

This number may be used in the usual manner to test the significance of the various differences between means of months and means of districts. For example, the standard deviation of the mean difference between any pair of districts is given by the usual formula,

$$\sqrt{\frac{0.011}{12} + \frac{0.011}{12}} = 0.105\sqrt{\frac{2}{12}} = \$0.041.$$

However, a much more general and appropriate method of testing is furnished by Fisher's test of the significance of the statistic z, defined as one-half the natural logarithm of the quotient of any two such mean squares as those in Table II. With a slight modification, common logarithms may be used as in the following example: It is required to determine whether or not the mean square between means of districts (0.099) is significantly greater than that due to sampling error (0.011). We have,

$$\begin{aligned}
&\log.\ 0.099 = 8.9956 - 10 \\
&\log.\ 0.011 = 8.0414 - 10 \\
&\text{Difference} = 0.9542 \\
&z = (0.9542)(1.1513) = 1.0986
\end{aligned}$$

The multiplier, 1.1513 ($=\frac{1}{2}$ of 2.3026) effects the division by 2 as well as the transformation to natural logarithms.

The distribution of the statistic, z, depends on the number of degrees of freedom, n_1, corresponding to the larger of the two mean squares as well as the number, n_2, corresponding to the smaller. Fisher [1] gives two tables of z, one tabulating the values which will be reached or exceeded in 5 per cent of samples drawn from a homogeneous population, the second, the values reached or exceeded by only 1 per cent of such samples. In the example above, $n_1 = 3$ and $n_2 = 33$. The 5 per cent value of z is, by interpolation, 0.5333, while the 1 per cent value is 0.7487. Since the value of z computed from the price data is larger than either, it is said to be highly significant—it would arise by chance less than once in a hundred samples drawn from a homogeneous population. The conclusion from this evidence is that geographic situation introduces heterogeneity into the producers' prices. The district means differ significantly among themselves.

In a very rough way it may be said that if one mean square is from three to ten times greater than another then it is significantly greater. Since the mean square due to differences between means of months is more than 400 times that due to sampling error, there is no point in testing for significance. The general price changes from month to month, affecting all districts, are the outstanding source of heterogeneity in producers' prices.

One may gain additional insight into the mechanism of analysis of variance by applying the method to the special case in which only two series of district prices are considered. For example, in Table III are exhibited the producers' prices for districts A and D. A standard

[1] R. A. Fisher, *Statistical Methods for Research Workers*, 3rd ed. rev. and enl., Oliver and Boyd, 1930, Table VI, pp. 212–215.

method would be to compute the twelve monthly differences between the district prices. The mean of these differences is \$0.199 with standard error, \$0.043.

TABLE III

IOWA HOG PRICES RECEIVED BY PRODUCERS FOR DISTRICTS A AND D BY MONTHS FOR 1930-31

(Dollars per 100 pounds)

District	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total
A.....	8.84	8.04	7.39	7.06	6.44	6.80	6.78	6.03	5.40	6.00	5.91	5.07	79.76
D.....	8.86	8.45	7.34	7.17	6.65	6.88	6.92	6.30	5.60	6.24	6.36	5.38	82.15
Total.....	17.70	16.49	14.73	14.23	13.09	13.68	13.70	12.33	11.00	12.24	12.27	10.45	161.91

Since the mean is more than four times its standard deviation, there can be little doubt as to the heterogeneity introduced into producers' prices by geographic locality. While analysis of variance is not an efficient method for treating this simple type of statistics, the results are exhibited in Table IV for the sake of comparison.

TABLE IV

ANALYSIS OF VARIANCE OF PRICES PAID TO PRODUCERS OF SWINE IN TWO DISTRICTS OF IOWA, 1930-31

Source of variation	Degrees of freedom	Sums of squares	Mean squares
Between means of districts.....	1	.238	.238
Between means of months.....	11	24.444	2.222
Sampling error.....	11	.123	.0112
Total.....	23	24.805	.....

The mean square due to district differences is more than 20 times that due to sampling error, so there is no question as to significance. Instead of testing z, therefore, it is of interest to compute the standard error of the mean difference. This is

$$\sqrt{\frac{.0112}{12}+\frac{.0112}{12}}=\$0.043,$$

the same result as that obtained in the standard method. This shows that analysis of variance is just as effective in eliminating the effect of temporal changes in prices as the method of differences. The distinct gain of analysis of variance comes when more than two sets of differences are being simultaneously investigated.

After completing the analysis of variance given in Table II, the study was extended to cover seven years. The period from October, 1924, to September, 1931, was treated as one sample and again the

TABLE V

IOWA HOG PRICES PAID TO PRODUCERS BY DISTRICTS, 1924–25 TO 1930–31

(Dollars per 100 pounds)

District	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Sum	Sum of squares
1924–25														
A	9.89	8.39	8.16	9.58	9.94	12.81	12.29	11.28	11.18	12.56	12.26	11.17	129.51	1,425.571
B	10.11	8.49	8.09	9.50	9.64	12.38	12.38	10.90	11.18	12.62	12.40	11.55	129.24	1,469.678
C	10.22	8.84	8.40	9.33	9.74	11.51	11.93	11.33	10.99	12.35	12.37	11.53	128.54	1,397.505
D	10.60	8.36	8.51	9.62	9.78	12.40	12.47	11.54	11.32	12.64	12.63	11.89	131.76	1,473.996
1925–26														
A	10.54	10.12	10.08	10.78	11.78	11.54	11.37	11.81	13.03	12.12	11.12	11.42	135.71	1,542.760
B	11.12	10.41	10.23	10.92	11.82	11.78	11.59	12.06	13.00	12.74	10.92	11.71	138.30	1,601.852
C	10.91	10.42	10.14	10.96	11.78	11.73	11.44	12.09	13.08	12.77	11.20	11.90	138.42	1,605.158
D	11.29	10.56	10.32	10.89	12.22	12.12	11.36	12.26	13.14	13.24	11.89	12.24	141.53	1,678.799
1926–27														
A	11.53	11.20	10.68	10.74	11.23	10.78	10.06	9.07	7.80	8.29	8.74	9.53	119.65	1,210.353
B	12.05	11.17	10.91	11.14	11.34	10.97	10.38	9.15	8.04	8.12	8.74	9.31	121.32	1,247.141
C	11.60	10.90	10.68	10.89	11.14	10.89	10.21	9.24	8.03	8.25	9.03	9.56	120.42	1,223.816
D	12.30	11.50	10.90	11.15	11.39	11.10	10.42	9.35	8.08	8.41	9.24	9.97	123.81	1,296.407
1927–28														
A	10.21	8.97	7.72	7.54	7.33	7.26	7.76	8.89	8.76	9.92	10.13	11.68	106.17	961.024
B	10.01	8.71	7.83	7.66	7.48	7.42	7.86	9.02	8.81	9.67	10.10	11.50	106.07	955.581
C	10.32	8.71	7.90	7.76	7.40	7.42	7.76	8.49	8.93	9.87	10.04	11.58	106.18	959.168
D	10.29	8.85	7.89	7.75	7.56	7.53	7.82	9.18	8.86	10.13	10.45	11.79	108.10	995.124
1928–29														
A	9.48	8.41	7.91	8.14	9.14	10.57	10.65	10.36	9.95	10.64	10.35	9.37	114.97	1,112.574
B	9.46	8.13	7.85	8.28	9.03	10.61	10.53	10.20	9.86	10.47	10.34	9.46	114.22	1,098.051
C	9.47	8.43	7.79	8.12	9.00	10.44	10.56	10.07	9.97	10.70	10.34	9.40	114.29	1,099.443
D	9.56	8.44	7.96	8.24	9.10	10.49	10.67	10.14	10.03	10.54	10.56	9.51	115.24	1,117.051
1929–30														
A	8.79	8.32	8.58	8.79	9.84	9.75	9.20	9.12	9.16	8.24	8.22	9.52	107.53	967.072
B	8.98	8.30	8.50	8.69	9.59	9.81	9.22	9.10	9.17	8.11	8.52	9.52	107.51	966.401
C	8.90	8.34	8.44	8.71	9.63	9.78	9.26	9.06	9.14	8.31	8.68	9.64	107.89	972.947
D	9.15	8.53	8.54	9.03	9.82	10.10	9.42	9.26	9.33	8.60	8.75	9.73	110.25	1,015.946
1930–31														
A	8.84	8.04	7.39	7.06	6.44	6.80	6.78	6.03	5.40	6.00	5.91	5.07	79.76	543.079
B	8.83	8.23	7.31	7.10	6.62	6.87	6.86	6.10	5.39	5.85	5.66	5.20	80.02	547.189
C	8.80	8.17	7.32	7.11	6.63	6.84	6.92	6.06	5.57	6.16	6.24	5.26	81.08	559.252
D	8.86	8.45	7.34	7.17	6.65	6.88	6.92	6.30	5.60	6.24	6.36	5.38	82.15	574.011
Total													3,199.64	31,566.949

variations were separated into three components: (i) between means of districts, (ii) between means of months, and (iii) sampling error.

Except for the fact that there are now 84 instead of 12 months the steps involved in obtaining the required calculations are identical with those already described. The arithmetic therefore need not be included. The analysis of variance is shown in Table VI.

TABLE VI

ANALYSIS OF VARIANCE FOR PRICES PAID TO PRODUCERS OF SWINE IN IOWA, 1924–25 TO 1930–31

Source of variation	Degrees of freedom	Sums of squares	Mean squares	Standard deviation
Between means of districts	3	2.748	0.916	....
Between means of months	83	1,089.015	13.121	....
Sampling error	249	5.852	0.024	.155
Total	335	1,097.615	.....	1.810

Upon increasing the number of months from 12 to 84 the mean square for "between means of districts" increased from 9 times to 38 times the size of the mean square for sampling error. The standard error of the difference between any two district means is reduced from $.041 to $.024 cents per 100 pounds, a reduction of slightly more than 40 per cent. Therefore, it is evident that the relative significance of the geographic variations in swine prices is greatly enhanced by extending the analysis to include seven years.

From the data in Table V it is possible to obtain some important additional information. By analysis of variance, it is possible to determine whether or not the intraseasonal and interseasonal movements of hog prices had any effect upon the price differentials between districts. To the student of prices these two relationships are of special importance. He wants to know: (i) Did the price differentials between districts vary significantly within the production year, which in Iowa runs from October to September; and (ii) did they behave differently in some years than in others? The first of these questions deals with the influence of the intraseasonal and the second with the interseasonal movement of hog prices upon their geographical pattern. Table VII, which gives the means of the 7 Octobers, 7 Novembers, etc. for each district, is based on Table V. What assurance is there that the differences between the means in Table VII are not the result of sampling error?

The intraseasonal analysis involves measuring the interrelation prevailing among the means of the 7 Octobers, 7 Novembers, etc., of the 4 districts. As noted above, the interrelation of two factors is called

TABLE VII

SEASONAL VARIATIONS IN THE AVERAGE PRICE OF HOGS PAID TO PRODUCERS IN IOWA, BY DISTRICTS, 1924-25 TO 1930-31

(Dollars per 100 pounds)

Months	Districts				
	A	B	C	D	D minus A
October	9.90	10.08	10.03	10.29	.39
November	9.06	9.06	9.12	9.24	.18
December	8.64	8.67	8.66	8.78	.14
January	8.94	9.04	8.98	9.12	.18
February	9.38	9.36	9.33	9.50	.12
March	9.93	9.98	9.80	10.09	.16
April	9.73	9.83	9.72	9.87	.14
May	9.51	9.50	9.48	9.72	.21
June	9.32	9.35	9.39	9.48	.1
July	9.68	9.65	9.77	9.97	.29
August	9.53	9.52	9.70	9.98	.45
September	9.68	9.75	9.84	10.07	.39
Average	9.44	9.48	9.50	9.68	.24

interaction. The corresponding sum of squares may be isolated in the same manner as was the component—sampling error—in the example given above. The price variations due to interaction would be zero if the price differentials between districts were the same for the 7 Octobers, 7 Novembers, etc. If the interaction is no greater than is to be expected from sampling error it is adjudged non-significant.

To isolate the interaction: (i) Between districts and months and (ii) between districts and years, the following calculations are necessary.

$$\text{The correction term} = \frac{(3199.64)^2}{336} = 30{,}469.334.$$

The sum of the squares of the 336 district-month prices appearing in Table V is 31,566.949.

(1) The total sum of squares of the deviations from the general mean therefore, is,

$$31{,}566.949 - 30{,}469.334 = 1{,}097.615.$$

(2) In calculating the sum of squares for "between means of districts" the block table on page 25 is helpful.

The first figure in the upper left-hand corner, 69.28, is the sum of the 7 October prices in district A, the next to the right the sum of the Novembers, and so on. The sum of squares for "between means of districts" is,

$$\frac{(793.30)^2+(796.68)^2+(796.82)^2+(812.84)^2}{84} - 30{,}469.334 = 2.748.$$

DISTRICTS BY MONTHS (7 YEARS)

Districts	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total
A	(7) 69.28	63.45	60.52	62.63	65.70	69.51	68.11	66.56	65.28	67.77	66.73	67.76	(84) 793.30
B	(7) 70.56	63.44	60.72	63.29	65.52	69.84	68.82	66.53	65.45	67.58	66.68	68.25	(84) 796.68
C	(7) 70.22	63.81	60.67	62.88	65.32	68.61	68.08	66.34	65.71	68.41	67.90	68.87	(84) 796.82
D	(7) 72.05	64.69	61.46	63.84	66.52	70.02	69.08	68.03	66.36	69.80	69.88	70.51	(84) 812.84
Total	(28) 282.11	255.39	243.37	252.64	263.06	278.58	274.09	267.46	262.80	273.56	271.19	275.39	(336) 3,199.64

The number 84 is used as the divisor because there are that many monthly district prices in each term of the numerator.

(3) For "between means of months,"

$$\frac{(282.11)^2+(255.39)^2 \ldots +(275.39)^2}{28}-30{,}469.334=52.672.$$

(4) Interaction between districts and months,

$$\frac{(69.28)^2+(63.45)^2 \ldots +(70.51)^2}{7}-(30{,}469.334+2.748+52.672)=1.056.$$

This second block table facilitates the calculation of the sums of squares for "between means of years" and interaction between districts and years. Note that the final column is a check on the sums for districts already used.

DISTRICTS BY YEARS (12 MONTHS)

Districts	1924–25	1925–26	1926–27	1927–28	1928–29	1929–30	1930–31	Total
A	(12) 129.51	135.71	119.65	106.17	114.97	107.53	79.76	(84) 793.30
B	(12) 129.24	138.30	121.32	106.07	114.22	107.51	80.02	(84) 796.68
C	(12) 128.54	138.42	120.42	106.18	114.29	107.89	81.08	(84) 796.82
D	(12) 131.76	141.53	123.81	108.10	115.24	110.25	82.15	(84) 812.84
Total	(48) 519.05	553.96	485.20	426.52	458.72	433.18	323.01	(336) 3,199.64

(5) For "between means of years,"

$$\frac{(519.05)^2+(553.96)^2 \ldots +(323.01)^2}{48}-30{,}469.334=697.903.$$

(6) Interaction between districts and years,

$$\frac{(129.51)^2+(135.71)^2 \ldots +(82.15)^2}{12}-(30{,}469.334+2.748+697.903)=1.006.$$

The final block table given below aids in computing the interaction between years and months. The final column and row again verify the sums for months and years used in the preceding computations.

YEARS BY MONTHS (4 DISTRICTS)

Months	1924–25	1925–26	1926–27	1927–28	1928–29	1929–30	1930–31	Total
	(4)							(28)
October	40.82	43.86	47.48	40.83	37.97	35.82	35.33	282.11
November	34.08	41.51	44.77	35.24	33.41	33.49	32.89	255.39
December	33.16	40.77	43.17	31.34	31.51	34.06	29.36	243.37
January	38.03	43.55	43.92	30.71	32.78	35.21	28.44	252.64
February	39.10	47.60	45.10	29.77	36.27	38.88	26.34	263.06
March	49.10	47.17	43.74	29.63	42.11	39.44	27.39	278.58
April	49.07	45.76	41.07	31.20	42.41	37.10	27.48	274.09
May	45.05	48.22	36.81	35.58	40.77	36.54	24.49	267.46
June	44.67	52.25	31.95	35.36	39.81	36.80	21.96	262.80
July	50.17	50.87	33.07	39.59	42.35	33.26	24.25	273.56
August	49.66	45.13	35.75	40.72	41.59	34.17	24.17	271.19
September	46.14	47.27	38.37	46.55	37.74	38.41	20.91	275.39
Total	(48) 519.05	553.96	485.20	423.52	458.72	433.18	323.01	(336) 3,199.64

(7) Interaction between years and months,

$$\frac{(40.82)^2+(43.86)^2 \ . \ . \ . \ +(20.91)^2}{4}-(30{,}469.334+697.903+52.672)=$$

$$338.440.$$

(8) For sampling error,

$$1097.615-[(2)+(3)+(4)+(5)+(6)+(7)]=3.790.$$

TABLE VIII

ANALYSIS OF VARIANCE FOR PRICES PAID TO PRODUCERS OF SWINE IN IOWA ARRANGED TO ISOLATE INTRASEASONAL AND INTERSEASONAL PRICE EFFECTS, 1924-25 TO 1930-31

Source of variation	Degrees of freedom	Sums of squares	Mean squares	Standard deviation
Between means of districts	3	2.748	0.916	.....
Between means of years	6	697.903	116.317	.....
Between means of months	11	52.672	4.788	.....
Interactions:				
Districts and years	18	1.006	0.056	.....
Districts and months	33	1.056	0.032	.....
Years and months	66	338.440	5.128	.....
Sampling error	198	3.790	0.019	.138
Total	335	1,097.615	.....	1.810

There is a total of 336 district-month prices in Table V which provide 335 independent comparisons and therefore yield 335 degrees of freedom. Similarly, 4 districts involve 3 degrees of freedom for the comparison between districts; 7 years provide 6 independent comparisons between years, hence 6 degrees of freedom; and, in the same way, 12 months give 11 degrees of freedom.

There are 3 independent district differences and for each of these the 7 years provide 6 independent comparisons or,

3 times 6 = 18 degrees of freedom.

Thus, 18 degrees of freedom are permitted for the interaction that arises from the different manner in which the district means vary from year to year. In a like manner, the interaction between districts and months gives,

$$3 \text{ times } 11 = 33 \text{ degrees of freedom.}$$

The interaction between years and months involves

$$6 \text{ times } 11 = 66 \text{ degrees of freedom.}$$

The degrees of freedom for sampling error are equal to the remainder,

$$335 - (3+6+11+18+33+66) = 198.$$

This figure may also be computed by multiplying the degrees of freedom for districts, years and months; that is,

$$3 \text{ times } 6 \text{ times } 11 = 198 \text{ degrees of freedom.}$$

As before, the mean squares in Table VIII are the important summary expressions of the analysis. The interaction between districts and months provides a measure of the influence of the intraseasonal price changes upon the price differentials that prevailed between the 4 districts. What is the statistical significance of the interaction? We have,

$$\begin{aligned} \log .032 &= 8.5052 - 10 \\ \log .019 &= 8.2788 - 10 \\ \text{Difference} &= 0.2264 \end{aligned}$$

$$\text{Calculated } z = (0.2264)(1.1513) = 0.2607.$$

By interpolation the 1 per cent point in Fisher's table for $n_1 = 33$ and $n_2 = 198$ is found to be approximately 0.2318. The calculated z is slightly larger and therefore we conclude that the interaction between districts and months is highly significant. This means that the intraseasonal movement of hog prices had different effects upon Iowa swine prices in the four districts. The changes in the differences of the prices in districts A and D are shown in the last column of Table VII.

Since each district-month mean in Table VII is the average of 7 Octobers, 7 Novembers, etc., its standard error becomes,

$$\sqrt{\frac{.0191}{7}} = \$.052 \text{ per 100 pounds.}$$

For the price difference between any two month-district means, for instance, those appearing in the last column of Table VII, the standard

error is equal to,

$$\sqrt{\frac{.0191}{7}+\frac{.0191}{7}}=\sqrt{\frac{.0191}{7}}\cdot\sqrt{2}=\$.074 \text{ per 100 pounds.}$$

We may therefore say with considerable confidence that prices paid for swine in southeastern Iowa, district D, were from 30 to 45 cents above the remainder of the state during the summer and early fall while during the rest of the year this price spread between district D and the other districts stood from 15 to 20 cents a 100 pounds in favor of the southeastern counties.

The mean square for the interaction between districts and years is tested for significance as follows:

$$\begin{aligned}\log .056 &= 8.7482-10\\ \log .019 &= 8.2788-10\\ \text{Difference} &= 0.4694\end{aligned}$$

$$\text{Calculated } z=(0.4694)(1.1513)=0.5404.$$

With $n_1=18$ and $n_2=198$, Fisher's tabular z at the 1 per cent point is about 0.3480. Inasmuch as our calculated z of 0.5404 is considerably larger than the 1 per cent value, we conclude that the price heterogeneity isolated in the interaction between districts and years is also highly significant.

Since there are 12 district-month prices in each district-year mean appearing in Table IX, the standard error of any district-year mean is

$$\sqrt{\frac{.0191}{12}}=\$.039 \text{ per 100 pounds.}$$

And the standard error for the price difference between any two district-means for any year is,

$$\sqrt{\frac{.0191}{12}}\cdot\sqrt{2}=\$.056 \text{ cents per 100 pounds.}$$

The importance of the interaction of districts and years is shown in Table IX. The price differentials of southeast Iowa over northwest Iowa virtually ranged from 50 cents a 100 pounds in 1925–26 to zero in 1928–29. The variations in the year to year price differentials between districts D and A are to be explained principally in the differences in the weight of hogs sold. Northwest Iowa markets a much heavier hog than southeast Iowa. As a result the two districts reflect the market premiums and discounts of their respective hog weights. For example, in 1925–26 light hogs sold at the highest premium over heavy

TABLE IX

AVERAGE ANNUAL PRICE OF HOGS PAID TO PRODUCERS IN IOWA, BY DISTRICTS, 1924–25 TO 1930–31

(Dollars per 100 pounds)

Year	District				
	A	B	C	D	D minus A
1924–25	10.79	10.77	10.82	10.98	.19
1925–26	11.31	11.52	11.54	11.79	.48
1926–27	9.97	10.11	10.01	10.32	.35
1927–28	8.85	8.84	88.84	9.01	.16
1928–29	9.58	9.52	9.52	9.60	.02
1929–30	8.96	8.96	8.99	9.19	.23
1930–31	6.65	6.67	6.76	6.85	.20
Average	9.44	9.48	9.50	9.68	.24

hogs since 1920, while during most of 1928–29 they actually sold for more than the lighter weights.

The economic results of this investigation are briefly: (i) It was found that the prices paid to producers in Iowa for swine were roughly 25 cents higher in southeast Iowa than in the remainder of the state; (ii) the price differentials between districts showed a very definite seasonal movement. From October through June they stayed fairly constant but widened materially during the summer and early fall months; and (iii) the price differentials due to geographic situation changed significantly from one year to another.

Summarizing, the advantages of the analysis of variance technique are: (i) It affords a strict mathematical procedure by which a great bulk of complex data may be readily reduced to a few summary expressions, i.e. the mean squares in the analysis of variance table; (ii) the arithmetic required to reduce the data first to sums of squares and then to mean squares is materially simplified compared with more common methods; (iii) it is in harmony with the theory of small samples first established by "Student"—the adjustment made by using the appropriate number of degrees of freedom; (iv) the method provides an exact test of significance in the z distribution developed by R. A. Fisher; and (v) it is the only efficient technique by which it is possible to isolate the heterogeneity and interpret the significance of a number of components simultaneously.

CONSTRUCTION STATISTICS

By Corrington Gill, *Federal Employment Stabilization Board*

The discussions and debates leading up to and following the passage of the Emergency Relief and Construction Act of 1932 indicate the lack of specific and accurate information available in this country on the subjects of construction and employment in construction.

Estimates of the volume of construction during any period of time are subject to wide divergence of opinion. This is particularly true with reference to the volume of work currently undertaken by the different types of constructing agencies. The number of men employed directly and indirectly in the construction industries must be estimated roughly. Considering the lack of accurate information, it is not surprising that even official estimates of employment per dollar of public expenditure for construction vary so markedly.

The possibility of stabilizing the construction industry by timing public construction operations inversely with the private building cycle invariably involves problems of financing both public and private construction operations. On this subject also, the available statistical data are meager.

Public officials, as well as private industry, must depend on available evidence for their opinions, and the validity of these opinions will depend upon the completeness and accuracy of the existing statistical data. The following outline of available current construction statistics is an attempt to evaluate their worth by describing sources of information and the methods of compilation.

VOLUME OF CONSTRUCTION

Ideally, we should have an exact measurement of the physical volume of construction activity under way at all times. Unfortunately, such information is not available. We do have data, however, which can be used in estimating roughly the dollar volume of construction. These are, first, construction contracts awarded as reported by the F. W. Dodge Corporation and other services; second, building permits, as compiled by practically all cities, and third, cross section studies such as the Census of Construction of 1929. When an attempt is made to reduce these dollar data to physical terms, the availability of only imperfect data on construction costs constitutes a serious obstacle to estimating physical volume. Each of these three types of volume data is important, but unfortunately all three have defects. A brief description of the three types follows:

Contracts Awarded

DODGE STATISTICAL RESEARCH SERVICE.—The F. W. Dodge Corporation was organized more than forty years ago to gather and disseminate information to the construction industry. The statistical reports, now a part of the Dodge Statistical Research Service, record construction contracts awarded since 1919. The reports have shown a consistent improvement from year to year. At the present time, they publish tri-monthly and monthly comprehensive data of contracts awarded for the 37 eastern states, broken down by value, number of projects, square feet, and types of construction. Historically, contract data on total construction in the New England States by months date back to January, 1901. From January, 1919, to April, 1921, their reports included data for 25 states east and north of and including North and South Dakota, Iowa, Missouri, Tennessee and Virginia, together with the District of Columbia and portions of Kansas and Nebraska. Beginning with May, 1921, figures for North and South Carolina were added and in January, 1923, reporting services were started in Florida, Georgia, Alabama, Mississippi, Louisiana, Arkansas and Oklahoma.

The Dodge Service covers not only contracts awarded, but also some work performed for owners by force account or day labor when reported by the Dodge representatives. The Service does not cover over 25 per cent of the construction and maintenance work of the railroads and public utilities, however. How important these latter expenditures are is seen from the fact that they amounted to over four billion dollars in 1930, and almost three billion dollars in 1931.

Even though the Dodge contract data are the most reliable for judging the volume of construction, certain limitations should be noted.

Data on contracts awarded do not measure the physical volume of construction work actually under way, as the award of the contract precedes the peak of activity on the project by an indefinite period of time. (Three months average lead probable.)

Classification of construction work has proved to be a very difficult problem, as is clearly indicated by the fact that the Dodge Corporation has found it necessary to change its classifications and groupings several times in the last few years. The shifting of interest is partially responsible for this changing classification. This is illustrated by the Dodge Service's recent segregation of public works and public utilities into two groups so that public utilities and public works data are now available separately.

The Dodge data have included contracts on alterations and repairs since January, 1932, which tend to limit their value in measuring new

construction. Dodge officials state that the broadened base does not seriously affect the comparability of the series over the entire period.

The Dodge data on contracts awarded were formerly limited to contracts of $5,000 or more. Beginning with 1932, their reports are for all contracts regardless of amount, exclusive of farm construction.

The Dodge contract information is gathered by reporters in the field, and the number of reporters varies from time to time. However, it is believed that the statistical service, being based as it is on a daily report service to contractors, building supply people, architects and others, is reliable for what it purports to cover, i.e., number of projects, number of square feet when possible to estimate, and the value of the contracts awarded in the 37 eastern States.

THE ENGINEERING NEWS-RECORD.—This publication reports weekly on engineering contracts only, as reported to them by correspondents in the field. This series appears to contain most of the public contracts awarded, as well as a high percentage of engineering contracts awarded. In the summer of 1932, the minimum contract price to be reported was lowered and consequently there is some possibility that the series after July will not be comparable to the series before that date. This change in minimum was made in an effort to adjust the dollar volume of contracts awarded to the lowered cost of construction. As costs started to fall three years before this change in minimum was made, the adjustment will not be effective during that period. The *Engineering News-Record* compilation of contracts awarded is broken down into six geographic areas, and by seven types of public construction and five types of private construction.

MISCELLANEOUS.—Several publications report on contracts awarded in their circulation area. These reports are usually incomplete and are not tabulated. Among periodicals publishing such information are the *Western Construction News*, the *Pacific Builder and Engineer*, the *Manufacturers Record*, the *Daily Journal of Commerce of Seattle and Portland*, and the *Dow Service* of New York City.

The Bureau of Labor Statistics began in December, 1930, to compile information on contracts awarded by the Federal Government. Since inaugurating this new series, it has reported on the awards made by the Architect of the Capitol, Office of the Quartermaster General of the War Department, Bureau of Yards and Docks of the Navy Department, Supervising Architect of the Treasury Department, the United States Veterans' Bureau and the Office of Public Parks and Public Buildings. (These agencies perform less than 50 per cent of Federal construction.)

The Bureau also reports on contracts awarded by state governments by months since the beginning of 1931. These reports are too incom-

plete to be of any value representing as they do less than 25 per cent of the construction contracts awarded by the states.

Building Permits

Obtaining a permit to build is made mandatory by law in most cities and theoretically at least a compilation of these building permits should indicate the volume of urban construction. For this reason many organizations have spent considerable time and effort in compiling time series of building permits issued in various cities. Such series now available are:

FEDERAL RESERVE BOARD.—This series covering building permits on a monthly basis begins with 166 identical cities in 1920, covers 167 cities from January, 1921, through September, 1921, and 168 cities from October, 1921, to date. These data provide the longest time series available by months on building permits.

THE COMMERCIAL AND FINANCIAL CHRONICLE.—This compilation is on an annual basis and is published each January in two separate series—first, annual totals from 1916 to date for 310 identical cities and the same tabulation plus 44 additional cities (total of 354) beginning with January, 1924. This annual tabulation is published for cities and states under the general heading of "Building Operations." Previous to 1916, the *Chronicle* published permit data covering a varying number of cities as far back as 1909, at which time permit values in 163 cities were given.

BUREAU OF LABOR STATISTICS.—The Bureau publishes information on building permits issued in the principal cities of the United States monthly. The number of cities varies from month to month. The Bureau's tabulation is the most comprehensive available on the subject of building permits issued in cities having a population of over 25,000. Data are available from 257 identical cities on an annual basis since 1921, and from 130 cities from 1914 through 1926. Their annual tabulation shows the estimated expenditures for new residential buildings, new non-residential buildings, total new buildings, alterations, additions and repairs, the number of families provided for, the ratio of families provided for to each 10,000 of population, an index number for each of these items, an index number of families provided for, weighted by population, and an average cost per family unit each year by type of building.

Beginning with September, 1929, the Bureau has been collecting and publishing monthly information in the same form as their annual material.

Since 1930 the Bureau has attempted to include public works (city,

state and Federal) in its compilation to remedy one of the most patent omissions in building permit data. This correction is not complete, however, as the Bureau's information on public works contracts is too incomplete to raise its building permit figures materially.

BRADSTREET'S.—Bradstreet has compiled, since 1909, annual series on building permits. Two separate series are available from this source —first, one containing data from 55 identical cities from 1905 to 1913, and second, another series containing data from 120 cities from 1909 to date. Bradstreet also publishes monthly information on building permits on non-identical cities which is comparable for only limited periods of time.

S. W. STRAUS AND COMPANY.—Although their report each month contains the data from the largest number of cities (over 600 in 1932) this source does not publish a series based on identical cities over a long period of time. Each issue of their *National Monthly Building Survey* contains permit data for that month, the previous month and the same month a year ago.

Favorable factors in the use of building permit data as a measurement of future building operations are:

These data are available on an annual basis from identical cities for a comparatively long period of time (Carl Snyder compiled an annual series covering 7 cities from 1882 to 1900 and Colonel Ayres covering 50 cities, 1900–21) and can be used to some extent in measuring long time trends.

Permit data are taken from city records required by law and are therefore more dependable than reporters in the field who may miss many projects.

The Bureau of Labor Statistics data measure the relationship between dollar expenditure and the number of families provided for.

The *unfavorable factors* are:

Data for different cities are not strictly comparable as the amounts recorded depend upon local ordinances varying as to the basis on which the building permit amount is based. In some localities the values of permits issued are constantly low, which is evidence of the effect of assessment laws on permit figures.

New York City and Boston do not require building permits. In these two cities local ordinances provide that "plans" must be filed. All of the series of permit information mentioned above include these two cities even though "plans filed" are not similar in meaning to "permits granted."

Permits do not measure suburban building. As much of the con-

struction during the years 1925 to 1928 took place outside city limits, building permits receded each year during this period in contrast to contracts awarded which reached their peak in 1928.

As permits total about half the contracts-awarded figure, they can be regarded as but half as good a sample as the contract data.

Permits do not measure engineering work, public work (generally speaking) and very little of the construction activity of the railroads and public utilities.

The fact that building permits may be granted and the work postponed indefinitely or even abandoned makes the permit data of dubious value if one wishes to measure the volume of construction work.

All permit series, except the Bureau of Labor Statistics "families provided for," are based on dollar value and have therefore the shortcomings of all such series during periods of changing construction costs as they fail to measure during such time the physical volume of construction. This would not be as important as it is were it possible to obtain a reliable index of building costs which could be used to deflate such a series. Unfortunately, however, this is impossible at the present time.

The chief exponent of building permit data as a measure of building operations is the *Commercial and Financial Chronicle.* It justifies this (January 30, 1932) by saying

> . . . we are inclined to think that the building figures which we and a few others undertake to collect furnish a better indication of the course of new building work than the records of contracts awarded, though it is not to be denied that these latter have a peculiar value of their own. In the first place, building permits deal with distinctively building work, and, in the second place, inasmuch as they represent projected work more largely than work actually begun, they are a much more valuable indication of intentions with respect to the immediate future. When award of a contract has been made, it almost invariably means that work will commence close upon the heels of the award. Not so when a plan is filed for a new building or for building work. Numerous considerations may, and often do, intervene to postpone the actual carrying out of the plans, and in most cases the contract for the work still remains to be awarded at some near or remote date. Thus it is unmistakably true that *intentions* with respect to new building work are more clearly and more definitely reflected by the building permit figures than by the other figures referred to.

All of the evidence available indicates that for the purpose of measuring the volume of construction nationally, the contracts-awarded data are far superior to building permits, although detailed data for individual cities are an aid in studying local building facts, and to some extent, an aid in estimating the building trend for the years preceding the inauguration of the Dodge Statistical Service.

Shipment of Building Materials

One of the best methods of estimating relative changes in the physical volume of construction is through the use of an index based on the shipments of construction materials from the factory to the job. It has been found that shipments follow the award of construction contracts by about two months and precede the employment of men in the field by about one month.

Shipment indexes have the advantage of being expressed in terms of physical volume rather than in dollars. Then, too, it is possible to make a rough test every two years with the Census of Manufacturers' data to insure the indexes against a fatal secular bias.

THE FEDERAL EMPLOYMENT STABILIZATION BOARD'S INDEX OF SHIPMENTS OF CONSTRUCTION MATERIAL.—This index contains thirty-one separate series each representing the shipment of a material used in construction. Each series has been studied to be sure that the source is reliable and that in practically every series the data represent reports from establishments producing at least 75 per cent of that particular material. The composite series begins January, 1925, and is the only index on the shipment of construction materials since the *Constructor* ceased compiling its shipment index in May, 1932.

THE INTERSTATE COMMERCE COMMISSION.—A statement of freight loadings for different commodities is published each quarter by the Interstate Commerce Commission, Bureau of Statistics. These statements show car loadings during the quarter of some twenty-one materials used in construction operations. The data begin with 1920. Between the years 1927 and 1928 a change was made in the classification of these commodities and it is necessary to make an adjustment between the first and second periods in compiling an index of these railroad shipments. These data confirm the Federal Employment Stabilization Board's index of factory shipments, but are not considered as practical because, first, they do not include shipments by water or truck; second, because they are on a quarterly basis; and third, because the information is not available as currently as the Board's monthly index.

Cross Section Studies

The information that has been discussed previously is in the form of time series. Another method of estimating the volume of construction for a given period of time is through the taking of a census.

CENSUS OF CONSTRUCTION.—After years of effort, contractors, building supply men, statisticians and others vitally interested in this subject were successful in obtaining authorization for a complete census of the construction industry for the year 1929.

The statistics developed by this census were obtained by questionnaires and field agents from contractors, manufacturers, fabricators of construction materials which they themselves used on construction jobs, and from dealers who operated a construction department in conjunction with their regular sales business. The enumeration covered the activities of general contractors, subcontractors and operative builders. Although the law did not make the filing of a report mandatory, if the work performed during the year amounted to less than $25,000, many contractors doing less than this amount of business did file returns and this sample has proved to be of some value in estimating work performed by small contractors.

The compilation does not include work performed by force account and one must, therefore, make allowance for the construction work not performed under contract by the railroads and public utilities in making an estimate of the total volume of construction.

The most serious obstacle to the use of the census data is the fact that they were not published in their entirety until late in 1932, two and one-half years after the period covered had elapsed.

The results of this census were published by states preceding the publication of the *United States Summary*. Each publication contained thirteen tables which are self-explanatory as enumerated below:

Table 1. Value of construction business during 1929, and principle items of expenditure.

Table 2. Construction business of reporting establishments during 1929, by class of ownership and by type of work.

Table 3. Construction business during 1929, by location.

Table 4. Construction business outside home state, by location.

Table 5. Number and salaries of proprietors, firm members, and salaried employees: 1929.

Table 6. Value of construction equipment, in comparison with construction business and wages paid during 1929.

Table 7. Wage earners, by months, and wages paid during 1929.

Table 8. Expenditures of reporting establishments: 1929.

Table 9. Cost of materials furnished and used by reporting establishments during 1929, by kind.

Table 10. Comparison of cost of designated materials furnished and used by reporting establishments during 1929, with cost of materials and value of construction business.

Table 11. Cost of materials furnished and used by reporting establishments during 1929.

Table 12. Number of and volume of business reported by establishments doing a construction business of less than $25,000 in 1929, percentage of total number of known establishments, and average volume per establishment.

Table 13. Establishments (whose business was less than $25,000 in 1929) which reported their volume of construction work, classified by range of volume of business.

Such a census is an invaluable aid to the student of the construction industry, but the cost of this census (about $250,000) makes an annual compilation of similar magnitude prohibitive, even assuming a lower cost for succeeding years.

FEDERAL CONSTRUCTION.—As a background on which to base conclusions on advance planning of the Federal Government's construction activities, the Federal Employment Stabilization Board in 1932 made a complete tabulation of all Federal expenditures for construction since 1920 by fiscal years and by constructing agencies. Table I shows the size of these construction expenditures.

TABLE I

FEDERAL EXPENDITURES FOR NEW CONSTRUCTION, REPAIRS AND ALTERATIONS BY FISCAL YEARS

Fiscal year	New construction, repairs and alterations
1920	$212,346,000
1921	245,777,000
1922	214,767,000
1923	197,278,000
1924	235,239,000
1925	271,292,000
1926	256,244,000
1927	256,237,000
1928	274,332,000
1929	308,037,000
1930	324,665,000
1931	473,825,000
1932 partly estimated	566,980,000

Compiled by the Federal Employment Stabilization Board

RAILROAD AND PUBLIC UTILITY CONSTRUCTION.—These perform much of their construction and maintenance work by their own employees without awarding a contract and without the necessity of obtaining a building permit. A comprehensive study of the volume of this work was made in 1932 by the Federal Government as an aid to timing construction activities. Table II contains a summary of this study.

TABLE II

ESTIMATED CONSTRUCTION AND MAINTENANCE EXPENDITURES FOR RAILROADS AND PUBLIC UTILITIES

(In millions of dollars)

	1923	1924	1925	1926	1927	1928	1929	1930	1931
Railroads	1,189	1,169	1,223	1,371	1,339	1,280	1,370	1,230	812
Electric Power Co.	822	934	884	823	844	813	906	968	654
Telephone Co.	409	491	502	534	545	613	795	817	604
Electric Railroad Co.	237	251	242	207	205	194	194	189	155
Sub Total	2,657	2,845	2,851	2,935	2,933	2,900	3,265	3,204	2,225
Pipe Line Co.	....	....	....	....	....	....	....	515	469
Gas Co.	....	....	....	....	....	....	....	226	167
Telegraph Co.	....	....	....	....	....	....	....	73	37
Waterworks Co.	....	....	....	....	....	....	....	44	25
Aviation Co.	....	....	....	....	....	....	....	7	6
Cotton Warehouses	....	....	....	....	....	....	....	3	3
Totals	....	....	....	....	....	....	....	4,072	2,932

Compiled by Federal Employment Stabilization Board

This compilation will be continued in the future and it is believed that the information will prove of value in filling in gaps left in the contract-award data.

FINANCING OF CONSTRUCTION

No phase of the construction industry is more obscure than financing. This statement applies with equal force to public and to private building operations. It is highly important to know the sources of money used and to be used in construction, the methods of financing permanent improvements, and the relationships existing between this financing and the money markets. A brief review of the few facts currently available will illustrate the paucity of this type of information.

Sources for Public Construction

Approximately one-half of the construction work performed by states, counties, cities and other political subdivisions is paid for from *general funds*. No adequate study of general fund financing is available although the *Financial Statistics of Cities and States*, published by the Bureau of the Census, throws some light on this subject.

Although general funds are used to supplement bond issues floated for specific permanent improvements by states, counties and cities, general funds are the only source used by the Federal Government in payment for construction work. During this past year many suggestions were made in Congress for the setting up of extraordinary budgets which would be used for public works but the innovation was not put into practice. The Treasury continues to sell Federal securities as

funds become depleted rather than to issue bonds specifically for permanent improvements.

The statement was made above that approximately one-half of the permanent improvements in the states, counties and cities was paid for from general funds. The other half is paid for by the *flotation of bonds* usually issued for a specific project. These bonds, whether for state, county, city or other political subdivision, are referred to as "municipals." Information on municipal bond flotations is available through two main sources—the *Commercial and Financial Chronicle* and the *Bond Buyer*.

Either of these series must be carefully used as an index of construction finance. To illustrate this point both series include New York City flotations in their tabulations. New York City financing methods since 1917 have not been comparable to those in any other large city. The usual method of financing outside New York City is the offering of a long term bond issue, the proceeds of which are used in payment for construction work. New York City, on the other hand, finances its construction activity by the issuance of short term Corporate Stock Notes, which are later funded into long term bonds. These long term bonds are included in both compilations of municipal bond flotations even though the proceeds are used actually to refund short term corporate stock. In the long run the effect is the same but in measuring the month to month variations New York City data must be deducted from either series.

Although *special assessments* are used to pay for many local improvements, no adequate record is available except that contained in the *Financial Statistics of Cities and States*, which is not published until over a year has elapsed following the period covered in the tabulation.

Sources for Private Construction

Financing of construction by the railroads and public utility companies comes from surplus, operating revenues or the flotation of bonds. There is no record available of the construction undertaken by these organizations from surplus. Interstate Commerce Commission's reports (monthly, quarterly and annual) show the expenditures by regions of the Class 1 steam railroads for maintenance of ways and structures and maintenance of equipment separately. The *Commercial and Financial Chronicle* and other financial publications compile information on the flotation of railroad and public utility bonds.

Private construction, such as residences and office buildings, are likewise financed through the borrowing capacity of the individual or firm, as well as through the withdrawal of savings. The borrowings

may be made from or through the building and loan associations, life insurance companies, banks or real estate bond houses.

BUILDING AND LOAN ASSOCIATIONS.—Building and Loan Associations are the most important financing agency for urban construction. The annual report of the Secretary of the United States League of Building and Loan Associations becomes available in the summer of each year. These reports show the number of members, total assets of the associations and total amount of mortgage loans outstanding at the end of the year. At the end of 1930 the associations numbered over twelve million members and had approximately eight and three-quarter billions in assets with over eight billion dollars of mortgage loans outstanding. What proportion of these loans are made for new construction and what proportion are made for other purposes is not known for previous years. Within the last year, however, several of the State Leagues have inaugurated a reporting system which now indicates from month to month the total amount loaned broken down into three classifications: loans for new construction; loans made on structures not previously financed; and other loans. The percentage of loans made for new construction varies materially from month to month indicating the impossibility of applying any definite ratio to annual mortgage loans in attempting to estimate the new construction financing of the Building and Loan Associations. For example, the data made available by the New York State Building and Loan Association League during 1932 show a variation of from 22 to 6 per cent between January and June in the percentage of new construction loans to all loans. With the passage of time these statistical reports of the Building and Loan Associations should prove of great value in estimating the current importance of the Building and Loan Associations' financing from month to month.

LIFE INSURANCE COMPANIES.—These are the second most important agency for financing buildings. At the end of 1931 fifty-two of the leading life insurance companies, whose combined assets represented 92 per cent of the total admitted assets of the legal reserve companies of the United States, held six and one-quarter billion dollars in mortgages. This series is available over a long period of years and gives an excellent picture of the trend of such holdings but does not present the facts on the month to month activity of the life insurance companies in the lending of money for new construction. The *Survey of Current Business* now publishes the mortgage loans outstanding each month but this does not give the loans made for new construction.

BANKS.—Financing of construction by the banks is important, but information available on their activities is inadequate. The Comp-

troller of the Currency's Annual Report contains information on banks showing their total real estate loans, mortgages, deeds of trust and other liens on real estate four times each year. No attempt is made, however, to obtain information even from national banks on the loans that they make to finance new construction.

REAL ESTATE BOND HOUSES.—The most comprehensive information on new capital issues is published by the *Commercial and Financial Chronicle* and dates back to 1919. The *Survey of Current Business* now publishes the *Chronicle's* report broken down into the types of buildings for which these long term issues were floated. This breakdown would be of great value if the underlying data were more complete. It appears, however, that the *Chronicle* series is but a sample of the total flotations of long term bonds through investment houses. One reason this series is comparatively small appears to be the fact that many mortgage bonds, the proceeds of which are to be used in the financing of new construction, are not offered publicly nor are they advertised and consequently, do not appear in a tabulation such as the *Chronicle's*.

Cost of Construction Credit

W. C. Clark, in an address before the American Statistical Association in December, 1931, stated that[1]

> Another vital aspect of the real estate market concerning which our data are of very little value is the matter of interest rates, or rather of the cost of urban mortgage credit—for interest rates and total cost are by no means the same thing. The market for building finance is a comparatively sluggish one. Interest rates on real estate mortgages change but slowly over a fairly long period of time. Adjustment to changing conditions of supply and demand for building capital is first effected through changes in underwriting discounts and expenses, which may vary over a rather wide range. Compilations of coupon rates on advertised issues therefore would in any case throw but little light on the real cost of mortgage money. Based on our inadequate records of real estate security issues, their defects are still further multiplied. These defects inhere in the series published monthly by the *Survey of Current Business* which shows the average coupons on the *Chronicle's* long term real estate bond issues offered by mortgage bond houses during the month. Moreover, as the real estate bond is so highly variable a commodity, the series is characterized by erratic short term fluctuations due merely to the different proportions in which issues of varying qualities happen to be combined in the monthly periods. Thus the declining tendency of the series of 1930 is an indication not of easing money conditions in the real estate market, but rather of the fact that difficult conditions had driven out of the market all but the most conservative lenders and all but borrowers of the highest quality. A satisfactory series would probably require the rating of issues and the calculation of average coupon rates for security groups or classes, each of approximately uniform quality. Occasional information in regard to the state of the mortgage

[1] *Proceedings of the American Statistical Association*, March, 1932, p. 141.

market and the prevailing range of rates for funds in various districts is published by the National Association of Real Estate Boards. We have also such studies as that of the Institute of Research in Land Economics and Public Utilities which show gross yields earned by the mortgage investments of the leading life insurance companies over a period of years. These yields, however, relate to all loans on the companies' books and are not an indication of current market conditions.

FORECLOSURES AND DEFAULTS.—No adequate data are available on foreclosures or defaults either public or private at the present time.

CONSTRUCTION COSTS

Difficult as the problem of measuring construction costs may be, the necessity is urgent enough to call for an exhaustive study.

Existing data on construction costs are inadequate to measure either the level of changing costs for different types of structures in different geographic locations or to indicate with any degree of certainty specific costs at a definite time.

General Indexes

There are three well known indexes which show the changing costs of general construction on a national scale, the *Engineering News-Record*, the New York Federal Reserve Bank and the *Constructor*.

All three of these indexes contain data on but two elements—labor and material. No index takes into consideration the cost of equipment or equipment rental, interest payments, contract bond premiums, compensation and liability insurance premiums, and other elements going into general overhead expense and profit. According to the Census of Construction the total value of construction business reported in 1929 was distributed as follows: wages 33 per cent; materials 47 per cent; other items 20 per cent. It can be seen by this cross section study that existing construction cost indexes completely disregard those items which total about 20 per cent of the total cost.

ENGINEERING NEWS-RECORD.—This index was started in 1917. After study, it was decided to base the index on four factors: the quoted prices for steel, lumber, cement, and labor. A study of the relative importance of these four factors indicated that they should be weighted as follows:

	Per cent
Steel	38
Lumber	17
Cement	7
Labor	38
	100

To arrive at these weights, quoted prices were taken for 2,500 lbs. of structural steel, f.o.b. Pittsburgh mill in carload lots; .6 M b.f. long leaf yellow pine at wholesale, delivered to dealers f.o.b. New York; 6 bbls. of cement f.o.b. Chicago in carload lots exclusive of the cost of bags; and 200 man hours of common labor in 20 cities. Monthly data for each of these four factors were found beginning with 1914 with the average of 1913 used as a base (100). Since that time the index has been carried forward without major revision. As a result of this method of using these four factors, subsequent price movements have shifted the weights and between 1917 and the middle of 1932 the following changes have occurred: steel, from 38 to 26 per cent; lumber, from 17 to 16 per cent; cement, from 7 to 5 per cent; labor, from 38 to 54 per cent.

The *Engineering News-Record's* cost index uses only three construction materials. It is doubtful that three materials are sufficient to give an accurate month to month measurement of building material costs. The fact also that the index is made up of published or quoted prices rather than actual prices being paid on the job makes this part of the index unrealistic in times of stress when contractors are able to buy materials at from 10 to 25 per cent under the quoted price. The argument advanced in favor of the use of these three materials is that they are three of the most important materials used in construction. (Twenty-four per cent of the total value of materials used by contractors in 1929 was represented by these three materials, according to the Census of Construction taken in that year.) Until 1930, the union rates of building labor were used. Since that time the labor factor has been computed by using a simple arithmetic average of the union, non-union and prevailing rates in 20 cities as reported by correspondents of this publication.

FEDERAL RESERVE BANK OF NEW YORK.—The Bank publishes an index which during periods of relative stability covers the cost of building quite accurately. The chief criticism of all cost indexes applies, however, with great force to this index during any period of change, inasmuch as both their material costs and their wage rates are quoted prices rather than prices actually paid. The index of building material prices (given a weight of 55 per cent in composite index) is now obtained from the revised index of the Bureau of Labor Statistics. Wage rates (given a weight of 45 per cent in the composite index) are computed from union wage rates of carpenters, bricklayers and laborers in 17 cities with each type of labor in each city weighted. This index starts in January, 1919.

THE CONSTRUCTOR.—This publication of the Associated General Contractors of America, weights its index with 40 per cent labor

costs and 60 per cent material costs. This weighting is more accurate than that used by the *Engineering News-Record* or the Federal Reserve Bank of New York, according to the facts developed by the Census of Construction. Up to and including April, 1932, *published wage rates* for hod carriers and common labor as published in the *General Building Contractor* were used. Realizing that these data did not represent wages actually paid, the Associated General Contractors asked twelve of their secretaries in widely separated cities to report each month the *actual wages* paid in their areas. This caused an apparent drop of over 15 per cent in this series between February and May, 1932. This index begins with 1913 as the base year.

TURNER INDEX OF BUILDING COSTS.—The Turner Construction Company has compiled an annual index of building costs. Officials of the company state

> First—We use union labor rates in the detailed calculations, but make an allowance after calculations have been concluded to cover indeterminable factors of which payment of labor at rates below the union scale is one. Second—we use prices actually paid for materials. Third—productivity of labor and efficiency of plant and management can be measured mathematically by comparing actual unit costs on similar work in different years. The effect of competitive conditions is one of the indeterminable factors. Fourth—our index is not actually computed in detail oftener than once a year.

BASED ON COST PER SQUARE FOOT (DODGE DATA).—Theoretically an index based on actual costs of construction should be the most accurate. It could be obtained easily each month by dividing the value of the contracts awarded by types by the square feet as reported for those types. This would give an average cost per square foot each month for all of the classifications used by the Dodge Corporation. Such a cost series would be automatically weighted correctly for the varying ratios between labor, material and other costs, as well as the varying ratios within each factor.

Unfortunately, however, many of the Dodge classifications do not lend themselves to this treatment inasmuch as no square foot data are possible for many types of public utilities, social and recreational projects, and public works. Other classifications such as residences, should lend themselves perfectly to this treatment, but this method does not lead to satisfactory results. Not only are the month to month fluctuations too erratic to lend credence to the method, but the level of square foot costs is not in accordance with what little knowledge we have on the subject. Some classifications, such as educational buildings, commercial buildings, public buildings and factories, appear to have cost more per square foot in June, 1932, than in 1928 and 1929.

The method is unsound because it does not allow for the changing type of construction. For example, in residential work the tendency to shift from speculative building to non-speculative building which has taken place during the past two years would upset such an index. Another reason for the failure of the method is that higher grade materials are now going into buildings, which tends to increase the cost per square foot. The Dodge data contain valuation but not square feet data for alterations and repairs which, at the present time, constitute a large percentage of the contracts awarded for residential types of building. The contract information in many cases includes expensive machinery and equipment for which segregation is not possible, thereby upsetting any calculations made on the basis of average cost per square foot. Calculating square foot cost by using Dodge contract data throws but little light on construction costs.

There appears to be no statistical information available on building costs based on cubic foot costs even though estimates on specific building projects are usually built up on a cubic foot basis.

Building Material Prices

Available indexes on the prices of materials entering into construction are unfortunately based on quoted prices rather than actual prices in almost every case. In addition to the material prices used by the *Engineering News-Record*, the *Constructor* and other construction costs sources, indexes of material prices are compiled by the Bureau of Labor Statistics, *The Annalist*, *Bradstreet's*, and the U. S. Department of Commerce.

BUREAU OF LABOR STATISTICS.—Beginning with January, 1913, the Bureau has compiled an index based on wholesale prices of building materials. This index now comprises monthly quotations for 112 separate materials entering into construction. It is an excellent index for quoted prices, but does not indicate at any time the wide divergence that may exist between quoted and actual prices.

THE ANNALIST.—The *Annalist* weekly index of wholesale commodity prices as at present constituted began with January 1, 1925, and contains a separate composite series on the cost of four building materials: lumber, brick, structural steel and cement. These quoted prices are available each Friday as of the preceding Tuesday and have the great advantage of prompt publication. The index is subject to the same criticism made against that of the *Engineering News-Record*. In the case of the *Annalist* the following weights are given to these four building materials: 28,192 M ft. of lumber, 4,553 M brick, 5,661,700 lbs. of structural steel, 86,141 bbls. cement. In each case the price is a

composite one as reported to the *Annalist*. With each shift in the quoted price for these materials their relative weight in the *Annalist* index changes.

BRADSTREET'S.—Bradstreet's index on the cost of building materials is based on quoted prices for brick, lime, cement, nails, glass, yellow pine, West Virginia spruce, and Douglas fir. The method used in weighting the individual materials consists of reducing these items to a per pound basis and taking a simple average of the sum.

U. S. DEPARTMENT OF COMMERCE, DIVISION OF BUILDING AND HOUSING.—This Division compiles a monthly index on the prices of building materials only weighted to represent the relative cost of constructing a six-room frame house and six-room brick house. These indexes are based on prices paid for materials by contractors in some 60 cities in the United States as reported by representatives of the Department of Commerce. The index numbers are given as of the first day of each month.

Specific Costs

A step in the right direction has been made by the American Appraisal Company, the Morton C. Tuttle Company, the Aberthaw Company, and A. S. Richey in compiling indexes representing the construction costs of various types of structures.

THE AMERICAN APPRAISAL COMPANY.—This Company compiles four separate indexes in an attempt to measure the cost of: (1) brick, steel and frame structures; (2) brick, wood and frame structures; (3) frame structures; and (4) reinforced concrete structures, based upon material and labor costs prevailing in nine territorial districts of the United States, weighted in accordance with cost percentages determined from buildings of each type actually constructed.

MORTON C. TUTTLE COMPANY.—The monthly index compiled by this Company is based on current prices of labor and materials contained in a building constructed by the Tuttle Company in New England in 1915.

THE ABERTHAW CONSTRUCTION COMPANY.—This index measures the relative changes in the cost of constructing a standard concrete factory building based on the actual cost of a concrete building in Connecticut in 1915. This cost index is brought up to date quarterly. The Aberthaw index declined 12 per cent from 1929 to July, 1932, while the Tuttle index showed a decline of 27 per cent, indicating that the latter gives a picture more in accord with current conditions than do the Aberthaw data.

A. S. RICHEY.—A. S. Richey of the Worcester Polytechnic Institute

compiles a monthly index, available since 1914, representing the construction costs for electric light and power construction. The index is a weighted average of items entering into total construction costs including conductors, electrical and mechanical equipment, labor, structures and several miscellaneous items. This index can be checked only by comparing it with cost studies based on actual experience in the electric light and power field.

RENTS

Important as rental data are in estimating the demand and supply of buildings there is very little material available on this subject. Only two indexes on rents exist—those of the Bureau of Labor Statistics and of the National Industrial Conference Board. Both of these indexes are used by their compilers as important elements in their studies on the cost of living.

THE BUREAU OF LABOR STATISTICS.—The Bureau's figures are based on rental rates of from 400 to 2,200 houses and apartments in 32 cities. The quotations are obtained by questionnaire from real estate agencies, based on the rent, unfurnished, for houses, flats and apartments of four or five rooms of a type which would be occupied by wage-earners and people on small salaries. Since 1924 these surveys have been made twice a year, in June and December. Previous to 1924 they were made at irregular intervals back as far as 1913, the base year.

THE NATIONAL INDUSTRIAL CONFERENCE BOARD.—The Board sends questionnaires each month to real estate boards, chambers of commerce, social agencies and to certain individuals who are in touch with the rental situation of their localities. Each coöperator is asked to state for the 15th of the month "the approximate average monthly rent for a house or apartment of four or five rooms, with bath, heat not furnished by the landlord, such as is usually occupied by wage-earners." At the present time reports are received from 173 cities—63 in the East, 38 in the South, 56 in the Middlewest and 16 in the far West. The average number of cities reporting during the year 1930 was 172 and the average number of reports received was 539. Only four cities with a population of 100,000 or more are not represented in the survey. The cities covered by the study range in population from 25,000 to 100,000. The index is computed by calculating the percentage of change from the previous month. The National Industrial Conference Board states:

> These percentage changes are averaged for each city and an index is determined for each city by linking the average percentage change to the index number of the previous month which is now computed on the base of December, 1928 (100).

The cities are then divided into five groups on the basis of population and an index for each group is found by the arithmetic mean of the indexes of the cities within each group. These group indexes are weighted on the basis of the total population in cities of each class in the United States, the result being the rent index for the United States as a whole on a December, 1928, base.

THE ALBERT WENZLICK REAL ESTATE COMPANY.—The Wenzlick Company has long been active in this field of research in St. Louis and has compiled two indexes of rents for greater St. Louis beginning with 1922. They are: (1) single family dwellings, per room, per month, and (2) apartments, per room, per month. No deduction is made for concessions which at least in the case of apartments have been almost universally allowed during the last few years, generally in the form of a free month on a year's lease. These indexes are compiled intelligently and offer a good example of what can be done in compiling rental indexes for a single locality.

VACANCY AND OCCUPANCY RECORDS

An understanding of the market for residences, apartments, stores, offices, factories and other types of buildings is essential to an understanding of the economics of construction. Such information is of a local character and for that reason it does not lend itself readily to national compilations with the very limited amount of information currently available.

U. S. DEPARTMENT OF COMMERCE, DIVISION OF BUILDING AND HOUSING.—The Division of Building and Housing has long advocated vacancy and occupancy surveys as the best method of obtaining local data on the real estate market. Local real estate boards are vitally interested in this research and have assisted and, in many cases, made surveys of this character. The most comprehensive report available is that compiled by the Division of Building and Housing on August 1, 1932. This report shows that 38 such surveys have been made in the last year. Two essentials to making such local surveys of national value are: (1) a definite and iron-clad classification of types of residences, offices, etc., covered; and (2) comparable dates among cities and if possible periodic surveys so that the trend in the locality may be ascertained.

Thus far such surveys have been limited almost exclusively to dwellings.

THE NATIONAL ASSOCIATION OF BUILDING OWNERS AND MANAGERS.—The Committee on Renting of this Association has conducted three surveys each year since 1924 to obtain information on vacancies in office buildings and new office buildings under construction. This survey

now includes reports from about 40 cities, covering approximately 2,000 office buildings with a total of approximately 175 million square feet of office space. It shows the square feet of vacant space and the percentage of the total that is vacant for each survey. Detailed data are shown by cities on a percentage basis only. Square feet of floor space contained in buildings under construction are shown by cities.

The value of this survey is indicated by this quotation from the survey bulletin of May 1, 1932:

> Percentage of vacancies indicates that for the past year absorption has not kept pace with the space added in new buildings. Also some cities report actual contraction due to present business conditions. Over the past few years the area of unoccupied space has increased greatly on account of the large amount of new building.

MISCELLANEOUS STUDIES.—Two rather complete surveys of individual cities have been made during the last three years. Denver, in 1929, was completely covered in a vacancy survey made by the local real estate board, through the coöperation of the Post Office Department. Albert Wenzlick and his associates have also made a thorough vacancy survey of St. Louis.

The ground work is now being laid in Cleveland, Ohio, by a representative of the National Conference on Construction, looking toward a complete building survey in this city in the months to come. In Cleveland the project will be financed by banks, the local Real Estate Board, members of the Chamber of Commerce and others. This survey should serve as an excellent experiment on how detailed a study can be made in a city the size of Cleveland and the resulting data should be of great value to those interested in the construction industry.

DIRECT EMPLOYMENT ON CONSTRUCTION

No accurate measurement of the number of men directly employed in building or construction operations is available, although estimates have been made from time to time by numerous people interested in this subject. The fact that these estimates have varied by as much as 100 per cent indicates the lack of basic information on this important problem.

Two statements of the number of men directly employed in construction will illustrate the wide divergence to be found even in official figures. The Census of Occupations in 1930 shows, 2,562,000 "gainfully employed" on construction and under "construction and maintenance of streets, roads, and sewers" an additional 453,000 or a total of over 3,000,000. On the other hand, the Census of Construction

indicates that there were only 1,008,000 directly employed on construction work. It appears reasonable to suppose from the methods and definitions used in compiling the information that these two figures constitute the maximum and minimum. The Census of Occupations probably represents the maximum figure. It is the opinion of Census officials that a great many answered "construction" even though the man on whom they were reporting—or for that matter, the man who reported his own occupation—may have been employed but a short time in this field during slackness in his own line. Thousands of men throughout the country turn to jobs in the building industry during the spring construction season even though they may be employed in other trades throughout the rest of the year. The Census of Construction probably represents too low a figure inasmuch as the questionnaires were answered by contractors doing a business of at least $25,000 in 1929, and did not cover employees working on construction not under contract.

These two cross-section studies are being supplemented at the present time by the Bureau of Labor Statistics' monthly series on employment and payroll in building construction. Work on these series began in 1930, and January, 1931, is the first month for which the sampling data are available. Table III indicates the progress in obtaining the data.

TABLE III

PROGRESS OF "EMPLOYMENT IN THE BUILDING CONSTRUCTION INDUSTRY" DATA

(Now being compiled by Bureau of Labor Statistics)

	Localities	Increase	Establishments	Increase	Employees	Employees per establishment
1931						
January	7	..	1,644	..	24,127	15
February	7	0	1,699	55	22,860	13
March	6	−1	1,777	78	24,304	14
April	8	2	2,099	322	32,496	15
May	14	6	3,072	973	46,002	15
June	23	9	4,333	1,261	65,370	15
July	28	5	4,984	651	70,415	14
August	30	2	5,058	74	70,440	14
September	33	3	5,926	868	78,132	13
October	33	0	6,243	317	73,756	12
November	46	13	8,214	1,971	83,287	10
December	54	8	8,737	523	88,136	10
1932						
January	63	9	9,323	586	77,576	8
February	70	7	9,295	−28	72,610	8
March	70	0	9,170	−125	62,637	7
April	71	1	9,875	705	85,503	9
May	72	1	10,094	219	79,260	8
June	78	6	10,349	255	81,581	8
July	78	0	10,521	172	87,289	8
August	78	0	10,464	−57	86,370	8
September	81	3	10,408	−56	85,392	8
October	81	0	10,397	−11	85,300	8
November	81	0	10,268	−129	78,979	8
December	..	..	.....	....	.....	..

Three questions of fact arise in estimating the value of this series statistically: First, are the localities representative? Second, are the reporting establishments representative? Third, will secular bias destroy the value of the data for comparisons other than seasonal? As yet but few reports are being received from the smaller centers of population and the localities are, therefore, not yet representative. Both union and non-union cities are included in this tabulation. Officials of the Bureau of Labor Statistics state that they are getting reports from about 80 per cent of the firms in the cities covered. From a sample testing of establishments, it appears that the data are fairly representative in this respect. This series *will* have a very heavy secular bias because of the heavy mortality among contractors, particularly in times such as these. The importance of this bias can be realized by remembering that the Bureau's index of factory employment had a downward bias of over 12 per cent between 1923 and 1929 when checked by the Census of Manufactures. Cross-section studies such as the Census of Construction in 1929 would be of inestimable help in correcting for any unavoidable downward or upward shift.

Previous to the Bureau of Labor Statistics' inauguration of its employment in construction series, many states had started to compile information relative to the men employed in building operations. Ohio was the first. Monthly data from that state are available beginning with the year 1914. By 1928, five other states had inaugurated such reporting: Wisconsin, Rhode Island, Pennsylvania, Illinois and Massachusetts.

Since January, 1931, the Bureau of Public Roads has compiled each month the number of men employed directly on Federal and state highways by states. These figures also show the number employed on maintenance work by states.

The amount of direct employment given per dollar of expenditure by types of work and by types of awarding agencies is a highly important problem deserving more attention than has been given to it. Three actual figures have been published. First, an expenditure of $5,785 on general construction under contract is equivalent to one employee on the job for one year, according to the Census of Construction data for 1929. Second, an expenditure of $3,826 for public roads will provide employment on the job to one man for one year, according to a statement made by Thomas MacDonald, Director of Public Roads. Third, one man is given one year's direct employment for each $5,000 expended on public buildings erected by the Federal Government, according to a statement issued by the Treasury Department.

INDIRECT EMPLOYMENT IN THE BUILDING INDUSTRY

Although it is impossible to measure accurately the employment involved in the manufacture and transportation of building materials and equipment, it is frequently heard that there are two men employed indirectly for each man employed directly in building. The materials and equipment involved are indicated in Table IV showing the building materials used during 1929, together with their relative importance.

TABLE IV

PERCENTAGE DISTRIBUTION OF EACH DOLLAR SPENT FOR MATERIALS BY ALL CLASSES OF REPORTING ESTABLISHMENTS THROUGHOUT THE UNITED STATES

(Reporting establishments which did a business of over $25,000 during 1929)

All material distributed by kind
Total value, $1,572,000,000

	Per cent		Per cent
Sand, gravel, stone, etc.	10.4	Roofing and sheet metal	3.6
Brick (face, common, etc.)	4.1	Finished flooring, other, etc.	.4
Tile (fireproofing)	.8	Screens, shades, etc.	.1
Tile (facing, etc.)	1.8	Heating and ventilating equip.	8.0
Concrete and cinder block	.7	Plumbing and gas-fitting equip.	8.3
Cut stone, granite, etc.	2.8	Electrical appl. and supplies	6.3
Riprap, rubble, etc.	.3	Elevators, dumb-waiters, etc.	3.3
Cement	8.9	Pipe (drain tile, vit., etc.)	1.3
Lime	.4	Pipe (cast iron, sheet, etc.)	2.1
Plaster, etc.	1.0	Wire cable, guards, etc.	.2
Structural steel	8.1	Bit. pav. materials, tar, etc.	1.6
Reinforcing steel	3.0	Wood piling and timber	.4
Cast iron, misc. exc. pipe	.5	Ready mixed concrete	.2
Metal doors, windows, etc.	1.1	Machinery	1.2
Metal and wire lath, etc.	.4	Freight, hauling, etc. to job	.3
Ornamental metal work	.9	Cast forms, beads, etc.	*
Lumber (rough and finished)	7.4	Chemicals and chem. products	*
Lath, shingles, etc. (wood)	.3	Metal products, n.e.s., etc.	1.2
Millwork	3.0	Mineral products, etc.	.1
Composition board	.5	Sealing materials	*
Waterproofing materials	.2	Textiles and caulking mat.	*
Hardware (rough and finished)	1.2	Miscellaneous	1.1
Paints, varnishes, glass	2.1		100.0

* Less than one-tenth of 1 per cent.
Census of Construction, 1929

In a study of indirect employment by states, the Federal Employment Stabilization Board, through the coöperation of the Bureau of the Census, compiled employment data showing the number of salaried officers, salaried employees and wage earners by states on the payroll of factories manufacturing 27 major building materials, 85 per cent or more of each material being used in building operations.

The Board has also compiled an index of employment in six industries manufacturing construction materials. The materials covered are: brick, tile and terra cotta, cast iron pipe, cement, millwork, steam fittings, and structural steel. The index measures month to month variation in employment covering approximately 40 per cent of those employed in the production of building materials. It is adjusted biennially with the Census of Manufactures to eliminate secular bias.

SCALES FOR MEASURING THE STANDARD OF LIVING

By Evelyn G. Tough and E. L. Kirkpatrick

The accumulation of data from studies of farm standards of living calls for the acceptance of a satisfactory unit for comparing the cost of the goods and services consumed annually. The family cannot be regarded adequate for this purpose, since it fails to take account of the fact that sex, number and age of persons composing it make a difference in the needs for food, clothing, rent and other economic goods and services. Some other unit or scale of comparison, with allowance for these differences, as well as for the first or basic costs borne by all families regardless of the number and ages of persons which they contain, would be found exceedingly useful.

Just what scales of measurement are possible for use in such comparison? How have they been developed? And what can be said of their adequacy as means of measuring the standard of living in terms of costs or expenditures?

This article gives attention to three sets of scales which have been used for comparing the cost of family living; the adult male equivalent, the ammain and the cost consumption unit. These are considered briefly from the standpoint of their development and more fully from the standpoint of their applicability and their adequacy as a means of measurement.[1]

ADULT MALE EQUIVALENT

There are a number of adult male equivalent scales all of which have the cost of living per family based against the consuming power of the adult male as unity or one. The exact age against which this "unity" is based varies, as do the relative weights allotted to other persons in the family.

The adult male equivalent scale regarded best suited for this test was developed by Carle C. Zimmerman for comparing the cost of living among farm, village and city families during 1924–26 and the years immediately following.[2] It is based on food computations of L. Emmet Holt as outlined in *Food, Health and Growth*, 1922. In this

[1] The test of comparability or adequacy here used is similar to that described by the writers in *The American Journal of Sociology*, Vol. XXXVII, No. 3 (November 1931), pp. 424–434. That test included only the adult male equivalent and the cost consumption unit for limited numbers of families.

[2] Carle C. Zimmerman, "How Minnesota Farm Family Incomes Are Spent," "Factors Affecting Expenditures of Farm Family Incomes," "Incomes and Expenditures of Minnesota Village and Town Families," and "Incomes and Expenditures of Minnesota Farm and City Families," *University of Minnesota Agricultural Experiment Station, Bulletins 234, 246, 253, 255.*

scale the expenditures per family annually for all goods and services are weighted against the consuming power of the adult male person 19–60 years of age, as unity. The relative weights allotted to other persons in the family by sex and age groups are:

	Weight		*Weight*
Males 19–60	1.0	Child 13, 14 and 15	1.0
Males above 60	0.9	Child 11–12	0.8
Females 19–60	0.8	Child 9–10	0.7
Females above 60	0.7	Child 6, 7 and 8	0.5
Males 16, 17 and 18	1.2	Child 4–5	0.4
Females 16, 17 and 18	0.9	Child 1, 2, and 3	0.3

This scale, as well as most other adult male equivalent scales, may be regarded as an inadequate measure for expenditures for all purposes since it is based on food only. Numerous studies of standards of living show that food absorbs only 25 to 50 per cent of the total cost of living. Obviously the expenditures for other goods and services may vary out of accord with the expenditures for food.

THE AMMAIN

The ammain scale was designed to go beyond the assumption that the expenditures for all goods and services for persons of different sex and ages vary in accord with the expenditure for food for these persons. It was developed by Edgar Sydenstricker and Wilford I. King as a means of classifying families according to incomes.[1] This scale weights the expenditures for all goods and services by persons of different sex and ages against the consuming power of the male, 23 to 26 years of age, at the maximum of consumption. The relative demands, weighted against the cost of all economic goods consumed by the male at this age —taken as unity or 1—vary from .22 at the first year of age up to 1.00 at the 23rd–26th year and down to .74 at the 80th year for males. They vary from .22 at the first year of age up to .79 at the 21st–25th year and down to .62 at the 80th year for females. Thus, the ammain scale with gradations by separate years from 1 to 80 for male and female is a more refined unit of comparison than the adult male equivalent.

The ammain scale of units would be a satisfactory means of comparing the costs of living for different families provided the same relative demands were made by the third or fourth or other member of the family on the separate elements of family living. This is not the case, however, for studies in rural standards of living particularly. These

[1] See "A Method of Classifying Families According to Incomes in Studies of Disease Prevalence," *Reprint 623 U. S. Public Health Service*, Public Health Service, November 26, 1930. Ammain indicates "adult male maintenance."

studies indicate that the supplementary or added costs for clothing for the son or daughter in the late teens are one and one-half times those for either parent while the added costs for food are about eighty per cent as much. Further, the added costs to meet the demands made by the third and other additional member of the family on the other elements of living, as rent, health maintenance, and education, vary with little or no regard to the total cost of living per family.

THE COST CONSUMPTION UNIT

The cost consumption unit scales used in the test were developed by Kirkpatrick in connection with a study of the standards of living among four hundred farm families of Livingston County, New York, 1921–22.[1] In this set of scales, as in Zimmerman's adult male equivalent scale, the consuming power of the adult male is taken as the base for weighting the family expenditures. The relative weights allotted differ, however, for each of the principal groups of goods and services as in Table I.

In this set of scales the adult female, the homemaker, is considered as having the same expenditures as the adult male for the different elements of family living, except food and personal goods and services. From actual figures the average cost of clothing was found to be about the same for the operator and homemaker. Probably both share use of the house, furnishings, health maintenance and operation and advancement goods and services about equally.

TABLE I

Food	First person in age and sex group	Each additional person in age and sex group
	Weights	
Male:		
19 and over *	1.0	0.9
15 to 18 inclusive	.8	.7
Female:		
19 and over	.9	.8
15 to 18 inclusive	.7	.6
Male or female:		
12 to 14 inclusive	.6	.5
6 to 11 inclusive	.4	.3
5 or less	.3	.2

[1] E. L. Kirkpatrick, "The Standard of Life in a Typical Section of Diversified Farming," *Cornell University Agricultural Experiment Station Bulletin 423*, and "The Relation of the Ability to Pay to the Standard of Living," *U. S. Department of Agriculture, Bulletin 1382*.

Clothing

	Weights
Operator	1.0
Homemaker	1.0
Other persons:	
Over 24 years	1.4
19 to 24 years	1.7
15 to 18 years	1.3
12 to 14 years	1.0
6 to 11 years	.6
1 to 5 years	.4

Rent

	Weights
Operator	1.0
Homemaker	1.0
Other persons:	
First male, 15 years of age or over	.2
First female, 15 years of age or over	.2
Second male, 15 years of age or over	.0
Second female, 15 years of age or over	.0
Third male, 15 years of age or over	.2
Third female, 15 years of age or over	.2
And so on	
First boy, 6 to 14 years of age	.1
First girl, 6 to 14 years of age	.1
Second boy, 6 to 14 years of age	.0
Second girl, 6 to 14 years of age	.0
Third boy, 6 to 14 years of age	.1
Third girl, 6 to 14 years of age	.1
And so on	
All under 6 years of age	.0

Furnishings. Household operation, and life and health insurance

	Weights
Operator	1.0
Homemaker	1.0
Other persons, regardless of sex or age	
First	.4
Second	.3
Third	.2
Fourth	.1
Fifth, sixth and others	.0

Maintenance of health

	Weights
Operator	1.0
Homemaker	1.0
Children:	
Over 24 years	.4
6 to 24 years	.2
Under 6 years	.6

Advancement

	Weights
Operator	1.0
Homemaker	1.0
Children, male or female:	
Over 19 years	.5
15 to 18 years	.3
6 to 14 years	.1
Below 6 years	.0

Personal goods

	Weights
Operator	1.0
Homemaker	.6
Children:	
Male 19 years and over	1.0
Male 15 to 18 years	.5
Male 6 to 14 years	.4
Female 19 years and over	.6
Female 15 to 18 years	.5
Female 6 to 14 years	.3
Male or female 5 years or less	.2

*The age groups of sons and daughters are considered from the physiological and the sociological standpoints. The age groups observed are the preschool age, 5 years or less; the grade-school age, 6 to 11 years; the grammar-school age, 12 to 14 years; the high-school age, 15 to 18 years; and the college and "choice of occupation" age, 19 years or over.

COMPARISON TEST OF THE THREE SCALES

In connection with a recent study of standards of living among nine hundred farm families of selected localities in Wisconsin it was found desirable to ascertain which of the three sets of scales was the more satisfactory means of comparison.[1] From the standpoint of labor involved in the calculations, the adult equivalent and the ammain were the most feasible. From the standpoint of the qualitative analysis, however, the cost consumption unit seemed to be the more desirable.

[1] See Stencil Bulletins 104, 105, 106 and 108, University of Wisconsin College of Agriculture, Extension Service 1930 and 1931, for tentative results of this study.

But would the results obtained by the use of the three methods be widely different? If so, which would prove to be the most nearly adequate means of comparison? Would the resultant figures obtained by the use of any one of them be more satisfactory than cost of living per family as a basis of comparison?

As a partial answer to these questions it was decided to test the three methods. The tests were applied to the 900 summaries obtained from the farmer's standard of living study in Wisconsin: that is, the three scales were applied to the same summaries or records. Pearsonian coefficients of correlation constituted the method of comparison.

The application of the adult male equivalent scale to a particular family consisting of husband, wife and five children of different ages and with expenditures amounting to $1,761, is illustrated in Table II.

TABLE II

APPLICATION OF ADULT MALE EQUIVALENT SCALE

	Individuals in family	Age of individuals	Relative weight
Males:	Husband	43	1.0
	Son	20	1.0
	Son	4	.4
Females:	Wife	43	.8
	Daughter	17	.9
	Daughter	13	1.0
	Daughter	10	.7
Total		..	5.8

The figure obtained by this method, 5.8, divided into the total cost of living, $1,761, gives an expenditure of $303.60 per adult male equivalent.

The application of the ammain scale to the family with the $1,761 cost of living is similar to the application of the adult male equivalent except for the weights allotted to the different individuals, as indicated in Table III.

TABLE III

APPLICATION OF AMMAIN SCALE

	Individuals in family	Age of individuals	Relative weight
Males:	Husband	43	.92
	Son	20	.98
	Son	4	.33
Females:	Wife	43	.73
	Daughter	17	.74
	Daughter	13	.55
	Daughter	10	.45
Total		..	4.70

The figure obtained by the ammain method, 4.7, divided into the total cost of living, $1,761, gives an expenditure of $374.70 per ammain for the family.

The application of the cost consumption unit scales to the same family is as in Table IV.

TABLE IV

APPLICATION OF COST CONSUMPTION UNIT SCALES

Individuals in family	Age (Years)	Food	Clothing	Rent	Furnishings
		Relative weights			
Males: Husband	43	1.0	1.0	1.0	1.0
Son	20	.9	1.7	.2	.4
Son	4	.3	.4	.0	.3
Females: Wife	43	.9	1.0	1.0	1.0
Daughter	17	.7	1.3	.1	.2
Daughter	10	.4	.6	.0	.0
Daughter	13	.6	1.0	.0	.1
Total or household size index	..	4.8	7.0	2.5	3.0

Individuals in family	Age (Years)	Operation	Health maintenance	Advancement	Personal	Insurance
		Relative weights				
Males: Husband	43	1.0	1.0	1.0	1.0	1.0
Son	20	.4	.2	.5	1.0	.4
Son	4	.3	.6	.0	.2	.3
Female: Wife	43	1.0	1.0	1.0	.6	1.0
Daughter	17	.2	.2	.3	.5	.2
Daughter	10	.0	.2	.1	.3	.0
Daughter	13	.1	.2	.1	.3	.1
Total or household size index	..	3.0	3.4	3.0	3.9	3.0

When the household size index figure was divided into the total expenditure for each group of goods and services, the expenditures per cost consumption unit were obtained as in Table V.

TABLE V

EXPENDITURES PER FAMILY AND PER COST CONSUMPTION UNIT

Family living	Expenditure per family	Household size index	Expenditures per cost consumption unit
Food	$519	4.8	$108.15
Clothing	263	7.0	37.53
Rent	500	2.5	200.00
Furnishings	8	3.0	2.67
Operation	160	3.0	53.33
Health maintenance	14	3.4	4.12
Advancement	162	3.0	54.07
Personal	35	3.9	8.97
Insurance, life and health	100	3.0	33.33
Total for family	$1,761	...	$502.17

The sum of expenditures obtained by the cost consumption unit method as illustrated above amounts to $502.17, compared to $303.60 obtained by the adult male equivalent method and $374.70 obtained by the ammain method. The difference among the three figures is wider for this particular family than for most of the families. There was practically no difference in the three figures for some of the families.

In order to increase the comprehensibility of the test it is interesting to note the range of expenditures by the three methods. The lowest adult male equivalent figure, for the 900 families was $92.98, the lowest ammain figure was $107.48, and the lowest cost consumption unit figure was $136.42. The highest corresponding figures were $1,822.06, $1,957.59 and $1,880.27. The mean adult male equivalent, ammain and cost consumption unit figures for the 900 families were $406.02, $471.16 and $489.03. The corresponding medians were $380.25, $432.00 and $458.70.

The first step in the comparison was the ascertainment of the Pearsonian coefficients of correlation for expenditures per adult male equivalent, expenditures per ammain, and the sum of expenditures per cost-consumption unit, each in relation to another. The coefficient of correlation for the expenditures per adult male equivalent and the expenditure per ammain is $.9431 \pm .0025$; that for expenditure per adult male equivalent and the sum of expenditures per cost consumption unit is $.8569 \pm .006$; and, that for expenditure per ammain and the sum of expenditures per cost consumption unit is $.8567 \pm .0002$.

The high correlation between the expenditures as ascertained by each two scales suggested that one is about as satisfactory as another as a means of comparison. This suggestion, however, could not be accepted as a final test. Another step was sought in the comparison, and attention was turned to the computation of Pearsonian coefficients for total cost of living per family and expenditure per adult male equivalent, total cost of living per family and expenditure per ammain, and total cost of living per family and the sum of expenditures per cost consumption unit. The coefficients in the three instances are $.4825 \pm .0173$, $.5015 \pm .0079$ and $.7729 \pm .009$.

Results from this step in the comparison suggested a similarity between the adult male equivalent and the ammain as methods of comparison. They indicated discrepancies between expenditure per adult male equivalent and the sum of expenditures per cost consumption unit, and expenditure per ammain and the sum of expenditure per cost consumption unit. On this account it was considered advisable to take the comparison a step further. An additional factor, net cash income per family, was chosen for a dependent variable, against which

to correlate expenditure per adult male equivalent, expenditure per ammain and the sum of expenditures per cost consumption unit, as well as the total cost of living per family. The coefficients of correlation for expenditure per adult male equivalent, expenditure per ammain, the sum of expenditures per cost consumption unit and total cost of living per family, with net cash income as the dependent variable are, $.2361 \pm .0212$, $.2514 \pm .0007$, $.3397 \pm .0199$ and $.3853 \pm .0192$.[1]

Owing to the similarity in results obtained by the adult male equivalent and the ammain scale further analyses were limited to the former in comparison with the cost consumption unit. The results obtained by these two methods were correlated separately with participation in local organization, attendance at church services, and extent of reading and radio auditing at home.[2]

Although the associations were not striking in any of the three instances, they were slightly more significant on the cost consumption unit basis than on the adult male equivalent basis.

Simple correlations between expenditure per adult male equivalent, expenditure per ammain, and the sum of expenditures per cost consumption unit indicate the three to be closely related. When each is correlated separately with total cost of living and net cash family income as dependent variables, the three scales appear to be less consistent. The correlations are higher for the cost consumption unit than for the adult male equivalent or the ammain. This alone, however, does not determine which of the three measures is the most satisfactory.

When the correlations are viewed in the light of qualitative judgments, the cost consumption unit method appears to be the most favorable. The greater exactness with this method gives a feeling of certainty, not given by either of the others. The more detailed attempt to account for the variations according to the different principal groups of goods and services adds to this feeling that the cost consumption unit is the most exact measure. As to the simplicity of the scales, however, the adult male equivalent and the ammain are the more readily applied. The adult male equivalent is even more readily applied than the ammain.

The three units of comparison have their separate fields. The adult

[1] Net cash income per family represents the difference between gross cash receipts from farming and all other sources and cash farm and other expenses, not including family living expenses for the year of study. It is the amount left for family living, for savings, or for re-investment in the farm business resources.

[2] Results of these analyses are available from an unpublished thesis "Development and Applicability of the Cost Consumption Unit and Adult Male Equivalent Scale to the Cost of Family Living," by Evelyn G. Tough, University of Wisconsin.

male equivalent and the ammain are similar, however, in their construction, application, and adequacy. If either one of them is adopted for a particular study, results are likely to be the same.

Generally, the investigator should be familiar with the characteristics of the various units of comparison before making a final decision as to which to use. If it is a question of the use of the adult male equivalent or the ammain in preference to the cost consumption unit, the degree of exactness desired in the study may well govern the choice.

THE STANDARD ERROR OF THE COEFFICIENT OF ELASTICITY OF DEMAND[1]

By Henry Schultz, *University of Chicago*

Let the demand function be

$$x = x(y, z, w, \ldots t), \tag{1}$$

where x stands for quantity, y for price, z, w, . . . for other variables, and t for time. The partial elasticity of demand is then

$$\eta = \frac{\partial x}{\partial y}\frac{y}{x}. \tag{2}$$

It is required to determine the standard error of η, given the standard errors of the parameters of (1).

It will be sufficient for present purposes to consider two special cases of demand functions: (1) that in which η is the same at every point on the curve, and (2) that in which η varies from point to point on the curve.

As an example of the first case we may cite the equation

$$x = Ay^{\alpha}e^{\beta t+\gamma t^2}, \tag{3.1}$$

which becomes, upon taking logarithms,

$$\log_e x = \log_e A + \alpha \log_e y + \beta t + \gamma t^2. \tag{3.2}$$

Here the elasticity of demand is a constant:

$$\eta = \frac{\partial x}{\partial y}\frac{y}{x} = \frac{\partial \log x}{\partial \log y} = \alpha. \tag{4}$$

If the demand equation (3.2) is fitted by the method of least squares, the process of fitting may be easily modified so that it will also yield the standard errors of all the parameters.[2] Then by (4)

$$\sigma_{\eta} = \sigma_{\alpha}.$$

The only difficulty that may arise in this connection is that when we fit (3.2) we are minimizing the sum of the squares of the logarithmic

[1] In the preparation of this paper, I have had the benefit of discussions with my friend and colleague, Professor Walter Bartky of the Department of Astronomy. The proof of (10.2) is his, and is somewhat neater than the one which I had developed. Professor Bartky also deduced another upper limit for σ_{η}, but as that limit gave consistently higher values than (10.2), it was considered less satisfactory than the latter.

[2] See my "Standard Error of a Forecast from a Curve," this Journal, June, 1930.

residuals of x, while we may really wish to minimize the sum of the squares of the residuals of x. The former procedure gives greater weight to the low values of x. But this can be overcome by properly weighting the observation equations of (3.2). In any event, the use of the second method of fitting is not likely materially to affect the value of a or its standard error when the data used are annual consumption and average annual prices, for the reason that the scatter of quantity on price (both variables being corrected for secular trend) is generally too small to enable us to say that the two values of a obtained by the two different methods of fitting are significantly different from each other.

As an example of the second case, we may take the equation

$$x=a+by+ct+dt^2. \tag{5}$$

The fitting of this equation by the method of least squares yields the standard error of b, as well as the standard errors of the other parameters. But the elasticity of demand, η, derived from this equation, namely,

$$\eta=\frac{\partial x}{\partial y}\frac{y}{x}=b\frac{y}{x}, \tag{6.1}$$

is a function of y and x, as well as of b. We are required to determine the error of this function.

Denote the foregoing expression by

$$\eta=\eta(b, y, x). \tag{6.2}$$

Then we know that errors Δb, Δy, and Δx in b, y and x, respectively, are related to a corresponding error $\Delta\eta$ in the function, by the equation

$$\Delta\eta=\eta_b\Delta b+\eta_y\Delta y+\eta_x\Delta x, \tag{7}$$

where

$$\eta_b=\frac{\partial\eta}{\partial b},\ \eta_y=\frac{\partial\eta}{\partial y},\ \eta_x=\frac{\partial\eta}{\partial x}. \tag{8}$$

This expression for $\Delta\eta$ holds for any kind of errors whatever. Thus, if Δb, Δy, and Δx were actual errors of measurement, with known signs, the magnitude and the sign of $\Delta\eta$ could be determined by (7).

In most statistical investigations, however, we are concerned with the *sampling* errors of the several variables, which are given approximately by the standard errors σ_η, σ_b, σ_y and σ_x.

If the correlations between b, y, and x were known, the value of σ_η would be given by the well-known relation

$$(9)\quad \sigma_\eta=\sqrt{\eta^2_b\sigma^2_b+\eta^2_y\sigma^2_y+\eta^2_x\sigma^2_x+2r_{by}\eta_b\eta_y\sigma_b\sigma_y+2r_{bx}\eta_b\eta_x\sigma_b\sigma_x+2r_{xy}\eta_x\eta_y\sigma_x\sigma_y}$$

where the r's are the coefficients of correlation between the variables indicated by the subscripts. But since they are not known, and since it is generally not safe to neglect them, it is desirable to determine an upper limit to σ_η, so that we may have at least some estimate of the sampling fluctuations of η. A simple expression for an upper limit may be obtained from (9) by treating all the partial derivatives as positive and replacing each correlation coefficient by unity. Since the r_{by}, r_{bx}, and r_{xy} are actually less than unity, we have

$$(10.1)\quad \begin{cases} \sigma^2_\eta<\eta^2_b\sigma^2_b+\eta^2_y\sigma^2_y+\eta^2_x\sigma^2_x+2|\eta_b\eta_y\sigma_b\sigma_y|+2|\eta_b\eta_x\sigma_b\sigma_x|+2|\eta_x\eta_y\sigma_x\sigma_y| \\ \quad<(|\eta_b\sigma_b|+|\eta_y\sigma_y|+|\eta_x\sigma_x|)^2 \end{cases}$$

or

$$(10.2)\quad \sigma_\eta<|\eta_b\sigma_b|+|\eta_y\sigma_y|+|\eta_x\sigma_x|.$$

To apply this equation we need the values of the partial derivatives and of the standard errors of b, y, and x.

The partial derivatives are obtained from (6.1), which gives

$$(11)\quad \eta_b=\frac{y}{x},\ \eta_y=\frac{b}{x},\ \eta_x=\frac{-by}{x^2}.$$

The standard error σ_b offers no difficulty, since it is determined in the curve-fitting process. There remains the determination of σ_y and σ_x.

The determination of σ_y gives rise to an interesting question. Since in fitting such a demand curve as (5) we generally minimize the sum of the squares of the residuals in x,

$$\sum_1^n v^2=\sum_1^n\left\{x_0-(a+by+ct+dt^2)\right\}^2,$$

we thereby assume that the independent variables y and t are free from errors. Shall we, therefore, put $\sigma_y=0$ in (10.1)? There could be no objection to this procedure if y were actually free from errors. But this is not true in general. The primary reason for making this assumption is that the assumption that both x and y are subject to error would either make it impossible to fit the demand curve (5) by the method of least squares, or would enormously complicate the process. It is clear, therefore, that under these conditions, to put $\sigma_y=0$ is to underestimate σ_η. But this is not so objectionable as it appears, since the standard error of the constant-elasticity $\eta=a$ deduced from (3.2) is also subject to the same limitation, for in fitting (3.2), the assumption is made that $\log y$ is free from error; the two standard errors would, therefore, be comparable to this extent.

We may, however, make some allowance for the standard errors in y, if we agree to compute our elasticity of demand for that point on the demand curve for which y has its mean value $y = M_y$.[1] Now the standard error of M_y has the well-known value

$$\sigma_{M_y} = \frac{\sigma'_y}{\sqrt{n-1}}, \tag{12}$$

where n is the number of observations, and σ'_y is the *standard deviation* of y, and is to be distinguished from σ_y, which, in this paper, is used to denote the *standard error of sampling* of a particular value of y. This assumption permits us to write

$$\sigma_y = \sigma_{M_y} \tag{13}$$

in (10.2).

For σ_x we may take either the quadratic mean error

$$\epsilon_x = \sqrt{\frac{[vv]_x}{n-m}}, \tag{14}$$

where n = number of sets of observations, and m = number of parameters in the demand equation; or the standard error of the function σ_f

$$\sigma_f = \epsilon_x \sqrt{\frac{1}{w_f}}, \tag{15}$$

where w_f is the weight of the function. These concepts are defined in my "Standard Error of a Forecast from a Curve."[2] The first is an approximation to the hypothetical "standard error of a single observation" of least-square theory, which is assumed to be typical of the entire set of observations, in so far as precision is concerned. The second concept is, it will be observed, not independent of the first, although it is not constant for different values of x.

In computing σ_η, however, it is best to use only

$$\sigma_x = \epsilon_x, \tag{16}$$

primarily because ϵ_x is much easier to compute than σ_f, and secondarily because the use of the latter in this connection gives rise to a logical difficulty.

Making the substitutions (11), (13), and (16), in equation (10.2), and using the least-square value for σ_b, we obtain for the upper limit of σ_η

$$\sigma_\eta < \left|\frac{y}{x}\sigma_b\right| + \left|\frac{b}{x}\sigma_{M_y}\right| + \left|\frac{by}{x^2}\epsilon_x\right|. \tag{17}$$

[1] Even if the elasticity is desired for any other point on the demand curve, it may still be worth while arbitrarily to assume that the (unknown) standard error of y is approximately given by the standard error of the mean of y.

[2] See note 2, p. 64.

As an illustration, we may compute by (17) the upper limit to the standard error of the elasticity of demand for sugar.

Using the adjusted data for 1890–1914, I have shown [1] that the demand for sugar is described excellently either by

$$x = 141.4y^{(-0.43016 \pm 0.06828)} e^{(0.00925 \pm 0.00129)t} \tag{18}$$

or by

$$x = 100.7 - (5.834 \pm 0.805)y + (0.6769 \pm 0.0772)t, \tag{19}$$

where x is the per capita consumption in pounds, y is the real (deflated) price in cents per pound, and t is time in years, the origins of x and y being at 0, 0, and the origin of t being at 1902. The figures preceded by $\pm$ are least-square standard errors instead of probable errors as given in the reference.

From (18) the elasticity of demand with its standard error is easily seen to be the exponent of y, for

$$\eta = \frac{\partial x}{\partial y} \cdot \frac{y}{x} = \frac{\partial \log x}{\partial \log y} = -0.43016 \tag{20}$$

and

$$\sigma_\eta = \pm 0.06828. \tag{21}$$

This value of η is, of course, a constant, independent of y, x, and t.

From (19), the elasticity of demand is

$$\eta = \frac{\partial x}{\partial y} \frac{y}{x} = -5.834 \frac{y}{x}, \tag{22.1}$$

which is an explicit function of y and x, and an implicit function of t. To determine its numerical value we must fix y and x; and to determine x, we must fix t, as well as y.

If we fix y and t by giving them their mean values $y = M_y = 5.057$, and $t = M_t = 0$ (since the origin was taken at 1902), we derive the value $x = 71.224$.[2] Substituting these values of y and x in (22.1), we have

$$\eta = -5.834 \frac{5.057}{71.224} = -0.414. \tag{22.2}$$

To obtain the standard error of this value, we must know the values

[1] *Der Sinn der statistischen Nachfragekurven*, Heft 10, Veröffentlichungen der Frankfurter Gesellschaft für Konjunkturforschung, edited by Dr. Eugen Altschul, Bonn, 1930, pp. 64–71, especially note 23.

[2] This happens also to be the arithmetic mean of x, because (19) is a straight plane, and we know that a straight plane, fitted by the method of least squares, must pass through the center of gravity of the observations. If the demand function (19) had not been linear, then the value of x obtained by giving the independent variables y and t their mean values would not have been equal to its mean value.

of the terms on the right-hand side of (17). The least-square procedure which was used in fitting (19) yields, or can be made to yield,

$$|\sigma_b| = 0.805, |\sigma_{M_y}| = 0.141, \text{ and } |\epsilon_x| = 1.846.$$

The values of y and x used in (22.2) also yield

$$\left|\frac{y}{x}\right| = 0.0710, \left|\frac{b}{x}\right| = 0.0819, \text{ and } \left|\frac{by}{x^2}\right| = 0.00582.$$

Substituting these values in (17), we obtain for the three terms

$$\left|\frac{y}{x}\sigma_b\right| = 0.0571, \left|\frac{b}{x}\sigma_{M_y}\right| = 0.0116, \text{ and } \left|\frac{by}{x^2}\epsilon_x\right| = 0.0107.$$

Their sum, 0.0794, is an upper limit of σ_η, or $\sigma_\eta < 0.0794$. This may be compared with the standard error derived from (18), namely $\sigma_\eta = \pm 0.0683$.

Generally the middle term adds little to the value of σ_y. Several random comparisons indicate that its inclusion rarely increases the standard error by as much as 30 per cent.

In a study [1] in which I have had occasion to apply formula (17)—or, rather, the more general formula (10.2)—to many different demand functions, I have found that it gives results which are fairly consistent with those derived by other methods.

[1] "A Comparison of the Elasticities of Demand for Selected Commodities Obtained by Different Methods," read before a joint meeting of the Econometric Society with the American Statistical Association, Washington, D. C., December 29, 1931; to that published in *Econometrica*.

THE STANDARD DEVIATION AS A MEASURE OF THE INTENSITY OF SEASONAL ADJUSTMENT

By R. von Huhn

To free a series of observations from its seasonal amplitude, various methods are being used at present. The seasonal factor having been determined and adjustments computed, seasonal undulations disappear and the adjusted observations show the smoothing influence of the conversion. Table I shows 264 observations of an economic phenomenon for the period 1910–31. These data show a strong seasonal movement. The periods 1910–16 and 1922–28, respectively, were selected as base periods for the index of seasonal variation.[1] Columns A and B show the unadjusted and adjusted units for the respective periods.

Table II shows a frequency distribution of the unadjusted and adjusted units for the periods 1910–31, 1910–16 and 1922–28. In the case of the first and second period, the seasonal factor based on the period 1910–16 was used for the adjusted units, whereas the period 1922–28 was first adjusted by the seasonal index having 1910–16 as a base and then by the seasonal index having 1922–28 as a base period. In each case the significant statistical measures of variation were computed, namely, the standard deviation and the coefficient of variation. The frequency distribution of unadjusted and adjusted units for the period 1910–31 (264 observations) shows that the actual units are distributed over a range of 20 class intervals, as compared with 14 class intervals after adjustment for seasonal variation. The movement of concentration of the adjusted values toward the class interval containing the arithmetic mean (29.27 units) takes place from the lower unit groups upward and from the higher unit groups downward. Chart I shows the distribution of unadjusted and adjusted units for 1910–31, after absolute frequencies have been reduced to a per cent basis. Comparison between the two frequency curves "unadjusted" and "adjusted" shows the marked concentration in case of the latter, the standard deviation for the unadjusted units being $\sigma_u = 10.72$ units as compared with $\sigma_a = 7.80$ units for the adjusted series, and the coefficient of variation being $V_u = 36.61$ and $V_a = 26.64$, respectively.

When computing the difference between the standard deviation of the unadjusted units and the adjusted units of the same period it appears that the larger this difference, by so much is the adjustment more

[1] The seasonal factors were computed by the method outlined by Wagemann. See: Dr. Ernest Wagemann, *Konjunkturlehre*, Berlin, 1928 (Verlag Reimar Hobbing, pp. 233–235).

TABLE I

TABLE I

Column: (A) Unadjusted; (B) Adjusted

Year	January		February		March		April		May		June		July		August		September		October		November		December	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
1910.....	29.7	22.9	25.9	23.9	20.8	24.3	18.6	24.4	18.4	24.1	18.2	23.7	17.9	23.1	18.5	22.2	20.9	21.5	23.8	21.2	27.2	20.5	29.7	20.7
1911.....	26.2	20.2	19.3	17.8	15.7	18.3	14.8	19.4	14.6	19.2	14.4	18.8	14.8	19.1	16.4	19.6	18.7	19.3	21.8	19.3	26.1	19.7	29.1	20.3
1912.....	29.3	22.6	26.8	24.7	21.2	24.7	17.4	22.8	16.9	22.2	16.7	21.8	17.0	21.9	18.2	21.8	20.6	21.2	24.0	21.2	27.8	21.0	28.2	19.7
1913.....	24.8	19.1	21.1	19.5	17.9	20.9	15.9	20.9	16.1	21.2	16.8	21.9	16.4	21.1	17.7	21.2	21.3	21.9	26.0	23.0	31.3	23.6	32.9	22.9
1914.....	29.8	23.0	25.3	23.3	22.2	25.9	16.4	21.5	16.9	22.2	17.2	22.4	17.5	22.6	19.1	22.9	22.5	23.2	23.7	21.0	28.2	21.3	31.9	22.2
1915.....	31.7	24.4	23.7	21.9	16.5	19.3	16.6	21.8	16.5	21.7	16.1	21.0	16.3	21.0	17.3	20.7	20.6	21.2	24.6	21.8	29.4	22.2	31.1	21.7
1916.....	28.8	22.2	24.2	22.3	18.2	21.2	17.7	23.2	18.5	24.3	18.9	24.6	19.9	25.6	21.6	25.9	25.3	26.1	30.4	26.9	34.9	26.3	38.3	26.7
1917.....	38.1	29.4	35.7	32.9	25.3	29.5	28.5	37.4	30.2	39.6	29.9	39.0	29.0	37.4	30.5	36.5	35.8	36.9	38.5	34.1	41.2	31.1	45.9	32.0
1918.....	48.9	37.7	45.8	42.3	30.9	36.1	30.4	39.9	30.6	40.2	29.5	38.5	33.0	42.5	35.2	42.2	39.1	40.3	44.9	39.7	51.7	39.0	59.3	41.4
1919.....	55.3	42.6	34.8	32.1	33.9	39.6	36.0	47.2	38.9	51.0	36.1	47.1	37.9	48.8	40.6	48.6	43.1	44.4	51.0	45.1	59.1	44.6	69.6	48.5
1920.....	60.9	47.0	48.5	44.7	40.5	47.3	36.6	48.0	37.5	49.2	35.9	46.8	37.8	48.7	42.5	50.9	48.6	50.1	54.6	48.3	62.9	47.5	67.1	46.8
1921.....	54.5	42.0	31.0	28.6	26.8	31.3	20.5	26.9	19.4	25.5	20.1	26.2	24.3	31.3	28.9	34.6	30.9	31.8	39.4	34.9	50.0	37.7	51.1	35.6
1922.....	31.7	24.4	31.4	29.0	19.5	22.8	20.0	26.2	20.9	27.4	20.2	26.3	20.3	26.2	20.6	24.7	27.3	28.1	34.6	30.6	43.6	32.9	47.2	32.9
1923.....	37.8	29.1	29.9	27.6	25.4	29.6	21.6	28.3	21.8	28.6	20.9	27.2	21.3	27.4	23.6	28.3	29.8	30.7	34.6	30.6	45.6	34.4	45.5	31.7
1924.....	35.4	27.3	33.6	31.0	20.4	23.8	19.1	25.1	19.8	26.0	21.1	27.5	22.8	29.4	26.1	31.3	31.8	32.7	38.2	33.8	45.8	34.6	49.9	34.8
1925.....	48.6	37.5	35.7	32.9	23.9	27.9	24.2	31.8	24.8	32.5	26.1	34.0	27.9	36.0	30.0	35.9	31.1	32.0	37.7	33.4	46.8	35.3	48.1	33.5
1926.....	36.3	28.0	28.9	35.9	24.1	28.1	24.8	32.5	25.2	33.1	25.7	33.5	25.7	33.1	26.4	31.6	31.5	32.4	36.8	32.6	44.9	33.9	47.6	33.2
1927.....	36.9	28.5	29.0	26.8	20.8	24.3	20.3	26.6	19.8	26.0	17.8	23.2	20.7	26.7	23.4	28.0	29.4	30.3	35.6	31.5	41.6	31.4	43.3	30.2
1928.....	38.2	29.5	29.1	26.8	23.4	27.3	22.8	29.9	24.2	31.8	23.9	31.2	25.6	33.0	27.4	32.8	31.4	32.3	34.9	30.9	39.6	29.9	42.9	29.9
1929.....	33.0	25.4	31.9	29.4	28.0	32.7	23.0	30.2	24.4	32.0	26.1	34.0	27.2	35.1	29.8	35.7	33.9	34.9	38.4	34.0	44.2	33.4	45.8	31.9
1930.....	38.4	29.6	31.8	29.3	21.3	24.9	21.5	28.2	20.0	26.2	18.6	24.3	18.8	24.2	20.6	24.7	25.3	26.1	26.5	23.5	31.7	23.9	26.8	18.7
1931.....	22.1	17.0	14.1	13.0	17.0	19.8	16.2	21.3	13.3	17.5	14.1	18.4	14.8	19.1	17.3	20.7	19.1	19.7	22.7	20.1	26.4	19.9	25.6	17.9

NOTE: Column B: Based on Seasonal 1910–1916.

1922.....	....	25.4	....	30.5	....	26.2	....	27.7	....	28.2	....	27.6	....	26.2	....	24.6	....	27.3	....	29.1	....	30.0	....	30.9
1923.....	....	30.2	....	29.1	....	34.1	....	30.0	....	29.5	....	28.5	....	27.4	....	28.2	....	29.8	....	29.1	....	31.4	....	29.8
1924.....	....	28.3	....	32.7	....	27.4	....	26.5	....	26.8	....	28.8	....	29.4	....	31.1	....	31.8	....	32.1	....	31.6	....	32.6
1925.....	....	38.9	....	34.7	....	32.1	....	33.6	....	33.5	....	35.6	....	36.0	....	35.8	....	34.1	....	31.7	....	32.3	....	31.5
1926.....	....	29.0	....	28.1	....	32.4	....	34.4	....	34.1	....	35.1	....	33.1	....	31.5	....	31.5	....	30.9	....	30.9	....	31.1
1927.....	....	29.5	....	28.2	....	28.0	....	28.2	....	26.8	....	24.3	....	26.7	....	27.9	....	29.4	....	29.9	....	28.7	....	28.3
1928.....	....	30.6	....	28.3	....	31.5	....	31.6	....	32.7	....	32.6	....	33.0	....	32.7	....	31.4	....	29.3	....	27.3	....	28.1

NOTE: Column B: Based on Seasonal 1922–1928.

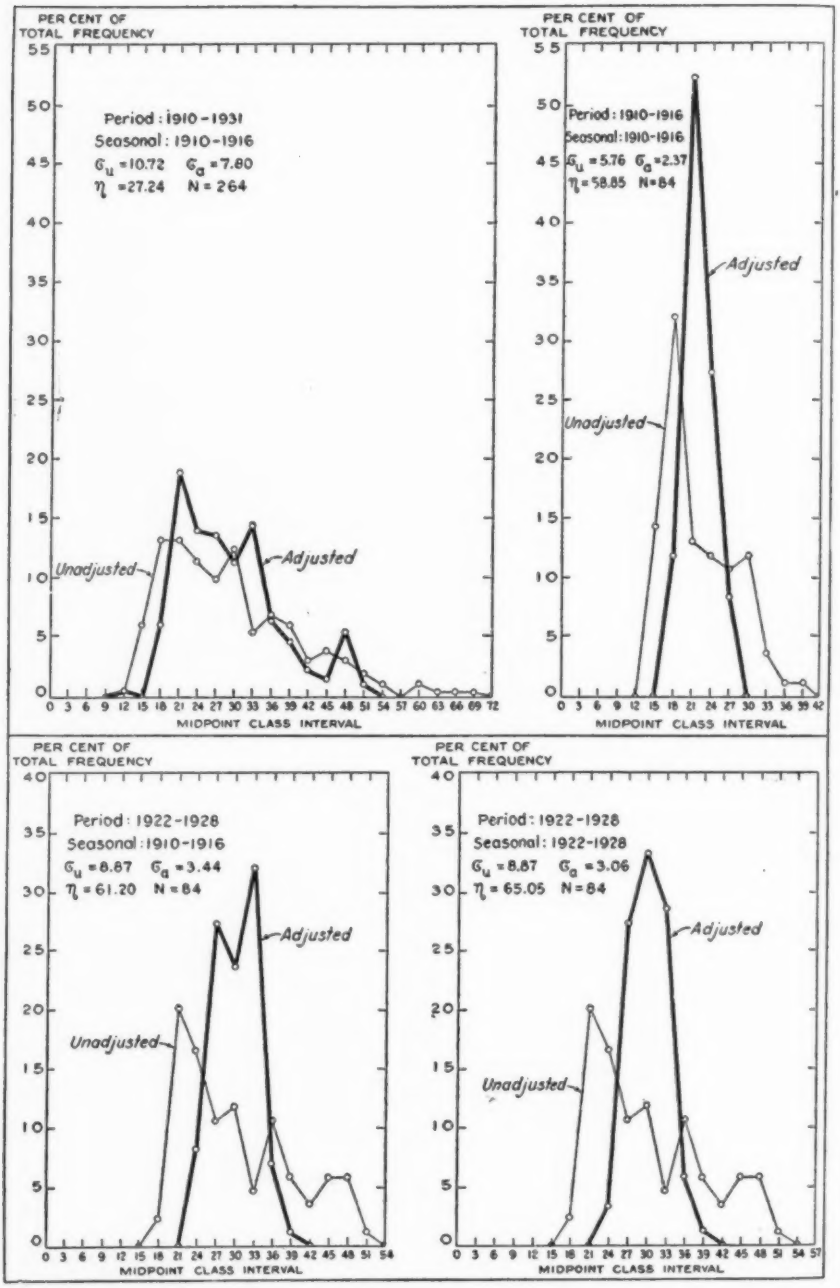

PER CENT OF TOTAL FREQUENCY
Period : 1910 - 1931
Seasonal : 1910 - 1916
σ_u = 10.72 σ_a = 7.80
η = 27.24 N = 264
Unadjusted
Adjusted
MIDPOINT CLASS INTERVAL
PER CENT OF TOTAL FREQUENCY
Period : 1910 - 1916
Seasonal : 1910 - 1916
σ_u = 5.76 σ_a = 2.37
η = 58.85 N = 84
Adjusted
Unadjusted
MIDPOINT CLASS INTERVAL
PER CENT OF TOTAL FREQUENCY
Period : 1922 - 1928
Seasonal : 1910 - 1916
σ_u = 8.87 σ_a = 3.44
η = 61.20 N = 84
Adjusted
Unadjusted
MIDPOINT CLASS INTERVAL
PER CENT OF TOTAL FREQUENCY
Period : 1922 - 1928
Seasonal : 1922 - 1928
σ_u = 8.87 σ_a = 3.06
η = 65.05 N = 84
Adjusted
Unadjusted
MIDPOINT CLASS INTERVAL

TABLE II

Class interval in units	Midpoint	1910–31, N=264, Unadjusted, Frequency, Absolute	1910–31, N=264, Unadjusted, Frequency, Percentage	1910–31, N=264, Seasonal 1910–16, Adjusted, Frequency, Absolute	1910–31, N=264, Seasonal 1910–16, Adjusted, Frequency, Percentage	1910–16, N=84, Unadjusted, Frequency, Absolute	1910–16, N=84, Unadjusted, Frequency, Percentage	1910–16, N=84, Seasonal 1910–16, Adjusted, Frequency, Absolute	1910–16, N=84, Seasonal 1910–16, Adjusted, Frequency, Percentage	1922–28, N=84, Unadjusted, Frequency, Absolute	1922–28, N=84, Unadjusted, Frequency, Percentage	1922–28, N=84, Seasonal 1910–16, Adjusted, Frequency, Absolute	1922–28, N=84, Seasonal 1910–16, Adjusted, Frequency, Percentage	1922–28, N=84, Seasonal 1922–28, Adjusted, Frequency, Absolute	1922–28, N=84, Seasonal 1922–28, Adjusted, Frequency, Percentage
7.50–10.49	9	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....
10.50–13.49	12	1	.379	1	.379	..	.....	..	.....	..	.....	..	.....	..	.....
13.50–16.49	15	16	6.060	..	.....	12	14.286	..	.....	..	.....	..	.....	..	.....
16.50–19.49	18	35	13.257	16	6.060	27	32.143	10	11.904	2	2.380	..	.....	..	.....
19.50–22.49	21	35	13.257	50	18.939	11	13.095	44	52.380	17	20.238	..	.....	..	.....
22.50–25.49	24	30	11.363	37	14.015	10	11.905	23	27.380	14	16.666	7	8.333	3	3.571
25.50–28.49	27	26	9.848	36	13.636	9	10.715	7	8.333	9	10.714	23	27.380	23	27.380
28.50–31.49	30	33	12.500	30	11.363	10	11.905	..	.....	10	11.904	20	23.808	28	33.333
31.50–34.49	33	14	5.303	38	14.393	3	3.571	..	.....	4	4.761	27	32.142	24	28.571
34.50–37.49	36	18	6.818	17	6.439	1	1.190	..	.....	9	10.714	6	7.142	5	5.951
37.50–40.49	39	16	6.060	12	4.545	1	1.190	..	.....	5	5.952	1	1.190	1	1.190
40.50–43.49	42	8	3.030	6	2.272	..	.....	..	.....	3	3.571	..	.....	..	.....
43.50–46.49	45	10	3.787	4	1.515	..	.....	..	.....	5	5.952	..	.....	..	.....
46.50–49.49	48	8	3.030	14	5.303	..	.....	..	.....	5	5.952	..	.....	..	.....
49.50–52.49	51	5	1.893	3	1.136	..	.....	..	.....	1	1.190	..	.....	..	.....
52.50–55.49	54	3	1.136	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....
55.50–58.49	57	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....
58.50–61.49	60	3	1.136	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....
61.50–64.49	63	1	.379	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....
64.50–67.49	66	1	.379	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....
67.50–70.49	69	1	.379	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....
70.50–73.49	72	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....
Total		264	99.994	264	99.995	84	100.000	84	99.997	84	99.998	84	99.995	84	99.996
Standard deviation		10.72		7.80		5.76		2.37		8.87		3.44		3.06	
Coefficient of variation		36.61		26.64		26.08		10.73		29.05		11.28		10.01	
Mean		29.27				22.07						30.54			
Coefficient of adjustment η=				27.24				58.85				61.20		65.05	

intense.[1] Therefore, if we designate σ_u = standard deviation of the unadjusted observations and σ_a = standard deviation of the adjusted observations, we have the following relationship:

$$\eta = \frac{\sigma_u - \sigma_a}{\sigma_u}$$

where η = intensity of adjustment.

[1] See also Raymond Pearl, *A Biometrical Study of Egg Production in the Domestic Fowl*, U. S. Department of Agriculture, Washington, D. C., May 28, 1909, Bureau of Animal Industry, Bulletin 110, Part I, pp. 68–69.

The limits of the magnitude of η are between zero and unity. If $\sigma_a = \sigma_u$, then $\sigma_a - \sigma_u$ becomes zero and obviously no adjustment has taken place and therefore η becomes zero; on the other hand, as σ_a approaches zero, $\frac{\sigma_u - \sigma_a}{\sigma_u}$ approaches unity and η approaches the maximum, or 1, hence η varies directly as the intensity of the adjustment.

TABLE IIA

	Seasonal factor	
	1910–16	1922–28
January	129.7	125.0
February	108.4	102.9
March	85.7	74.4
April	76.2	72.1
May	76.2	74.0
June	76.7	73.3
July	77.6	77.6
August	83.5	83.8
September	97.1	99.9
October	113.0	119.0
November	132.5	145.1
December	143.4	152.9
Total	1,200.0	1,200.0

We are now in a position to measure by the respective standard deviations of the various periods the influence which various seasonal factors have on the adjustment of a series of observations.

Therefore, η assumes the following values for the periods indicated:

(a) 1910–31 (seasonal 1910–16)

$$\eta = \frac{\sigma_u - \sigma_a}{\sigma_u} \times 100 = \frac{10.72 - 7.80}{10.72} \times 100 = \frac{2.92}{10.72} \times 100 = 27.24 \text{ per cent}$$

(b) 1910–16 (seasonal 1910–16)

$$\eta = \frac{\sigma_u - \sigma_a}{\sigma_u} \times 100 = \frac{5.76 - 2.37}{5.76} \times 100 = \frac{3.39}{5.76} \times 100 = 58.85 \text{ per cent}$$

(c) 1922–28 (seasonal 1910–16)

$$\eta = \frac{\sigma_u - \sigma_a}{\sigma_u} \times 100 = \frac{8.87 - 3.44}{8.87} \times 100 = \frac{5.43}{8.87} \times 100 = 61.20 \text{ per cent}$$

(d) 1922–28 (seasonal 1922–28)

$$\eta = \frac{\sigma_u - \sigma_a}{\sigma_u} \times 100 = \frac{8.87 - 3.06}{8.87} \times 100 = \frac{5.81}{8.87} \times 100 = 65.05 \text{ per cent}$$

Now when comparing the coefficients of adjustments for the various periods it will be noted that for the period 1910–31 the effect of the adjustment was only 27.24 per cent as compared with the period 1910–16 for which the seasonal was computed and for which the effect of the adjustment was 58.85 per cent. Obviously this must be ex-

pected as all other adjustments outside the base period of the seasonal index are, so to speak, extrapolations. When changes take place in the unadjusted and adjusted units outside the base period of the seasonal index the magnitude of η consequently changes accordingly and may increase or decrease as the case may be.

Making further comparison of the coefficients, we find that the effect of the seasonal on the unadjusted units for the period 1922–28 (based on seasonal 1922–28) amounted to 65.05 per cent and is larger than for the period 1910–16. This conclusion is also supported by the fact that the coefficient of variation for the period 1910–16 equals 10.73, and for the period 1922–28, 10.01. This points to the fact that the seasonal factor for the period 1922–28 must have a larger amplitude and therefore the effect of the adjustment is stronger. In Table IIa we find that the seasonal factor for 1922–28 has actually a larger amplitude than for the period 1910–16.

If the seasonal factor for the 1910–16 period is applied to the unadjusted units of the period 1922–28, the effect is smaller (61.20 per cent) than if the seasonal for the same latter period is used, which substantiates the conclusion that the amplitude for this period has changed.

Whenever the intensity of the seasonal adjustment or the magnitude of η for any other period outside the base period of the seasonal index is smaller or larger by a considerable degree, we must conclude that the relative amplitude of the seasonal has changed and consequently a new seasonal factor should be computed; on the other hand, if η has remained constant, or nearly constant, we deduct that the relative seasonal amplitude has not changed at all, or very little, and furthermore that the adjustments which have been extrapolated beyond the base period of the seasonal are the same, or nearly the same, as if the seasonal index had been computed based on a new period.

The magnitude of η will also change according to the method of computation of the seasonal index, and consequently η may serve as a measure by which it is possible to compare the effect of the intensity of adjustment for various methods for computing the seasonal amplitude.

NOTES

BUSINESS CURVE BASED ON INTEREST RATES AND PRICES

AN ADAPTATION OF THE QUANTITY THEORY OF MONEY

By O. M. Smart

This curve is the result of an experiment to see whether a business curve could be built up from gold, interest rates and prices. Such a curve might have some forecasting value at times when monetary factors were causative, and at other times at least provide a different angle of approach.

The following factors are used:

G = United States monetary gold stock (plus the silver stock) expressed as per cent of $5,300,000,000 (roughly the average value for the period 1920 to date).

I = Average of commercial paper and time money rates in New York (adjusted for seasonal variation).

X = British Exchange (per cent of par adjusted for seasonal variation).

S = Price of Silver (Shanghai Exchange as per cent of $.6685, 1913 average).

P = Average of commodity prices (USBLS and *Times Annalist*) and industrial stocks (*Times Annalist*, see 1931 Annual Number).

An equation for business conditions employing these factors was derived from a somewhat broad interpretation of the quantity theory of money. Stated in its usual form this is:

$$\frac{M\,R+D\,R'}{N}=P$$

where

M = Money
R = Rate of turnover of money
D = Deposits
R' = Rate of turnover of deposits
N = Number of transactions
P = Price level

transposing,

$$\frac{M\,R+D\,R'}{P}=N$$

N was assumed to be a measure of business conditions.

P was assumed to be an average of stock and commodity prices.

$M\,R+D\,R'$ was replaced by G, I, X, S, on the theory that the monetary gold stock would represent M, the interest rate would reflect the expansion or contraction of the credit structure, and X and S would give adjustments for foreign conditions.

Making the above substitutions we have:

$$\text{Business conditions} = B = f\left(\frac{G, I, X, S}{P}\right).$$

In order to evaluate this function we assumed business conditions to be the American Telephone and Telegraph Company curve, and by a process of trial and error obtained the following equation using data from 1920 to date.

$$B = 18\,G\,I[1.06\,\frac{S}{P} - 2.28\,(1.00 - X)] + .53.$$

This equation was obtained after experimenting with a variety of different forms including exponential functions; it is not, however, by any means the last word. In fact, two other forms have been worked out which give nearly the same results and which may prove eventually to be better.

With this brief description of the construction of the curve, it will be seen that the idea was to see what might be obtained from an attempt to force a fit of these factors into one of the standard business curves based on production. The form of the equation into which the factors were fitted was obtained from the quantity theory of money.

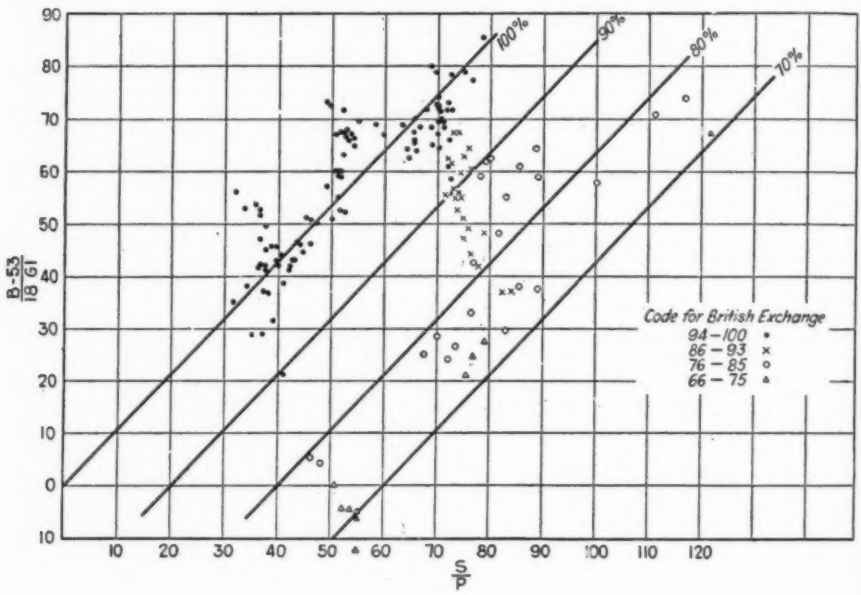
Much might be said both for and against the choice and definition of the items making up this equation. These arguments will be apparent to students of economics. It should be emphasized, however, that it is purely experimental.

The coefficients and final form of this equation depend for their validity solely on the fit obtained. No validity attaches to them as a result of the type of mathematical process followed in getting the equation (since this was purely cut and try). As regards method, however, in order to take some of the mystery out of it, it might be said that it was finally determined by first assuming that it would be of the straight line form and obtaining parameters 18 and .53 by trial and error as follows:

$$B = 18\,f\left(G, I, X, S, \frac{1}{P}\right) + .53.$$

The rest of the equation was determined from a three variable graphic set-up in which the three variables were $\frac{S}{P}$, X, and $\frac{B-.53}{18GI}$. This resulted in a system of parallel lines as shown in Chart I. This grouping of terms was used because it results in a rather simple system

CHART I



of parallel equidistant lines, but several other combinations will give equally good results, such as S, X, and $\frac{(B-.53)P}{18GI}$. This combination results in a system of non-parallel lines. There might be an advantage in introducing P twice in the equation with the grouping $\frac{S}{P}$, $\frac{X}{P}$, and $\frac{(B-.53)}{18GI}$.

Our assumption that the short-term interest rate would directly rather than inversely measure the expansion and contraction of the credit structure appears to work very well for the post-war period. For the pre-war period it does not work so well, but decidedly better

than if an inverse relationship were used. Since this curve is primarily one of interest rates as far as month-to-month fluctuations are concerned, this is equivalent to assuming that business and short-term interest rates are directly rather than inversely correlated as is often assumed. Of course, there are plenty of reasons why a set-up based on post-war data would not fit pre-war data but as a matter of fact the lack of fit for the pre-war period seems to consist principally of a lag which might be due to the absence of a central bank. Also there is a wider amplitude of fluctuation which might be due to the same cause.

An obvious source of error would be a reduction in the effectiveness of the gold stock due to hoarding by banks and individuals if this hoarding proceeded far enough to make the short-term interest rate go up in times of slack business. Most of this trouble would be cured by using a four-month lag of interest rates for the period before the War. Error in the curve due to this cause has evidently not been present since the establishment of the Federal Reserve System, and although it may occur in the future, it should be possible to diagnose such a situation when and if it occurs.

The pre-war period as at first plotted from the above equation also showed a lack of fit in having a decidedly lower normal level. The most probable cause of this seemed to be that the price element in the equation included no series for wages. There has been a wide spread between wages and commodity prices since the War that did not exist before the War. It was found that if Carl Snyder's index of wages were averaged with the other two prices, P would be increased by an almost constant amount, about .20 for the period analyzed 1920–1932.

In the equation, therefore, $P'-.20$ can be substituted for P where P' is an equally weighted average of commodity prices, security prices and Carl Snyder's index of wages. This will give practically identical results for the period 1920 to date and correct the difference in level for the pre-war period. Also, it will provide for the effect of further deflation of wages in the future. This change avoids the labor of a complete recalculation of the correlation and suggests that Carl Snyder's Index of General Prices might have been used in the first place.

The curve has been plotted therefore from the following equation:

$$B=18\ GI\left[\frac{1.06S}{P'-.20}-2.28\ (1-X)\right]+.53.$$

For the pre-war period an adjustment for the lag of interest rates might have been made and the amplitude of fluctuation cut down but it is thought to be of more interest plotted exactly as it came out.

During the period when gold exports were prohibited in the United

CHART II

Production Curve
Interest Rate Curve
Silver included
Silver excluded
Production Curve
Interest Rate Curve

States, from September, 1917, to June, 1919, the adjustment for both silver and sterling exchange was dropped. The dotted line Chart II shows where the curve would have gone if this had not been done. The fact that the jump and subsequent drop in the curve synchronizes so well with these dates makes it seem plausible that the price of silver has no significance when gold exports are prohibited. As regards sterling the case is not so clear as it was pegged so near par that it would make little difference whether it was included or not.

England went off from a gold basis in May, 1917. It is evident that during the period from July, 1914, to May, 1917, when the gold basis was still in operation, the effect of variations in the exchange was opposite and much greater in degree. An analysis of this period might be interesting but it is not thought worth while to complicate this paper by an attempt to treat it, since wide fluctuations in exchange with the gold basis in operation are normally impossible.

Probably the biggest objection to this curve will come from the inclusion of the price of silver. Without it the correlation falls down quite completely at all important points. It is suggested that its importance as a measure of exchange may be in connection with transfers of gold and silver to India and China rather than trade in ordinary commodities.

Another effect of the inclusion of silver is that no correction for trend is necessary either in the curve itself or any of the components. In this connection attention is called to an article in this JOURNAL, June, 1932, by L. C. Wilcoxen on "World Prices and the Precious Metals."

A great deal of discussion could be given regarding theoretical bases of assumptions made and conclusions which might be drawn, but this would involve going rather deeply into the subject of economics and this article is intended to be simply a presentation of a statistical experiment.

THE RICHARDS-ROOPE TANGENT METER

The idea of using a reflected image for the location of the tangent point of a curve is not new. Charles S. Slichter in his *Elementary Mathematical Analysis* (New York, 1914) page 220, mentions a mirrored ruler for drawing the tangent to any curve and he refers to Gramberg *Technische Messungen* 1911; and Otto Prölss in his *Graphisches Rechnen*, Teubner, Leipzig, 1920, refers to the same method (page 101). These devices do not make direct measurements, however. An instrument [1] for the direct measurement of the tangent function at any point of a curve was first described by Professors Richards and Roope in *Science* March 14, 1930. In conjunction with the Scientific Bureau of the Bausch and Lomb Optical Company, Rochester, New York, Professors Richards and Roope have made some improvements on the instrument reported at that time and the Bausch and Lomb Optical Company is now offering it for sale in this form. The instrument is based on the principle of the reflection of a point through an isosceles prism revolving with a metal ring which in turn holds a disc of glass. The prism is mounted large face down on the glass disc in such a way that the lateral edge is directly in line with the center. The rotable metal disc carries an angle degree scale on one side and a tangent function scale on the other. For the degree scale a vernier is supplied. Tangents to unity (45°) may be read directly within 2/100. The writer investigated the curve $y=7x^3$; $\frac{dy}{dx}=14x$ and found for $x=3$; $\frac{dy}{dx}=42.5$ instead of the actual 42.0 which represents an error of plus 1.19 per cent for this particular reading. The instrument is especially useful in all cases where it is difficult to compute the algebraic expression for a given curve itself and consequently the differential quotient. This occurs frequently in the case of curves of the higher order. A great deal of time can be saved because it is possible to measure rates at intermediate intervals without repeating tedious numerical computations. Doubtless the instrument could be improved by using finer scale divisions. The physical scale lines cut by the dividing machine measure now about 3/10 of a millimeter for both the degree and tangent scale. A circular scale made of the same material as used for slide rule scales and paragon scales would improve visibility and permit much finer graduations.

The engineer, biologist and economist will find the instrument a very convenient tool for determining rates of change of any phenomenon in their particular field.

R. VON HUHN

ECONOMIC CHANGE AND FINANCIAL READJUSTMENT

A dinner meeting of the American Statistical Association was held on Tuesday evening, October 18, 1932, at the Hotel Governor Clinton, Thirty-first Street and Seventh Avenue, New York City. One hundred thirty persons were present.

[1] See Direction Sheet: Use of Richards-Roope Tangent Meter No. 33–19–05. Bausch & Lomb Optical Company, Rochester, New York.

Dr. W. Randolph Burgess, Deputy Governor of the New York Federal Reserve Bank, presided. The general topic for discussion was *Economic Change and Financial Readjustment.*

The first speaker of the evening was Dr. David Friday of A. G. Becker and Company. He spoke on "The Credit Debacle." Dr. Friday began by emphasizing the necessity for studying, more carefully than hitherto, the economic changes which are taking place. We should know more than we do about the rules of growth characterizing various types of industries and also about the effects of such growth. For example, a question of prime importance is what is going to happen to the steel industry. In the metal work of the future, is steel to be replaced largely by alloys?

The speaker stressed the fact that many of the financial difficulties which are now being experienced are merely the products of economic changes of the past. The fashion, at present, is to blame bankers for the failures of the banks which they have managed. The truth is, however, that, in most cases, these banks have failed, not primarily because of the bad management of the bankers, but because of forces over which they have had no control, and the outcome of which neither they, nor others, were in a position to foresee. Those who fought Bryan in 1896 felt that, when free silver was defeated, comparative stability of the price level was assured. Nevertheless, although the gold standard was maintained, the price level quadrupled between 1896 and 1920, and, since the latter date, has been cut more than half. Such change is a far cry from stability. Between 1900 and 1910, the total value of all farms in the United States doubled. In the next decade, this aggregate again doubled. Between 1896 and 1920, banks increased in number from 7,500 to 28,000. Now, more than 10,000 of these have failed. When land values were rising steadily, country bankers invested heavily in farm mortgages, believing these to constitute investments of the highest quality. When they made these investments, practically everyone agreed they were right.

When farm land was selling near the top, C. R. Chambers investigated the relationship between land values and rents. He found that anticipated rentals were being discounted at the customary rate of 5 to 6 per cent. Since most people believed that rentals would advance along a straight line at approximately the gradient followed during the preceding decade, land was valued so highly that current rentals were at the rate of only 3 per cent on the valuation. Life insurance companies, as well as banks, frequently loaned so much money on farms that the entire rent was only large enough to cover interest payments. Few, however, realized that this practice was dangerous. It is now clear that the loans on both rural and urban real estate, made during the period of prosperity, were too high, but this was not evident until the fall of the price level.

For a long time now, rising land values have been accompanied by rising taxation. Between 1900 and 1930, factory wages in Michigan were multiplied by 12. The total land value in the city of Detroit was multiplied by 10 and the total amount of taxes levied, by more than 10. Now that the price level has fallen, the annual tax rate represents 3½ per cent of the value of the land.

The motor age has made it possible for the city resident to live five times as far

out from the center of the city as formerly. This means that 25 times as much land has become available for residential purposes. Can urban land values recover under these conditions? Dr. Friday felt this to be the type of question worthy of very careful investigation.

The second speaker of the evening was Mr. Ivy Lee, who discussed "Some of Our Unsolved Problems." Mr. Lee stated that political leaders, generally, refuse to face the real problems confronting the country. They prefer to deal with questions which are interesting to the public and, as Walter Lippmann says, "What is of interest to the public is seldom interesting to the public."

Mr. Lee expressed the view that the true source of prosperity lies in the maximum exchange of goods on an international basis. Ever since the Armistice, all the nations of the world have been engaged in devising ways and means of impeding the exchange of both goods and money. These obstructions are, in substantial measure, responsible for the depression.

Mr. Lee pointed out that although, on the whole, the United States is, in many respects, a self-contained Nation, this is not true of important sections of the Nation. For example, we produce twice as much cotton as we use. The Texas farmer can market his cotton only if he sells it abroad. It does not help him to know that the foreign trade of the Nation constitutes but 10 per cent of our total trade. If Texas is to prosper, she must be able to sell her cotton abroad.

The second unsolved problem mentioned by Mr. Lee was how to balance world production of and world consumption of leading commodities. The tendency in recent years has been for production to outrun consumption. Certainly there have been few intelligent efforts to organize stability. Some progress has been made in coördinating sugar production with sugar consumption. Such coördination should be extended to all other leading commodities.

The third outstanding problem is that of inter-Allied debts. It is obviously impossible for Europe to pay us in gold. If we wish payment, we must accept goods, yet we erect barriers to prevent entrance of the goods. When Europe borrowed during the War, she borrowed orders to buy goods in the United States. Lord Cecil has suggested that it is only fair that, in payment of the debt, Europe should give to the United States orders to buy goods in Europe. This proposal is worth considering. Someone has said that, as a matter of fact, the whole structure of Allied debts was a corpse before the Lausanne Conference. There it was cremated. The only real question now remaining is when we shall bury the ashes.

The fourth problem touched upon by the speaker was the question of money—the operation of the gold standard. He stated that, before the World War, in many European countries gold circulated about as freely as paper money. Now its employment as a circulating medium has ceased, and it is used only for bank reserves and to settle international balances. The operation of the gold standard in the future must depend upon a new type of coöperation between Central Banks.

What we most need is a stable standard of value, added Mr. Lee. The price level affects fundamentally every phase of our life. The failure to establish a stable price level constitutes, therefore, an indictment on human intelligence.

A pound of copper is always a pound; a gallon of oil is always a gallon; a yard of cloth is always one yard—but a dollar is not always a dollar. Its value is what it will buy—and that constantly changes. We need a fixed standard of deferred payments so that the amount which the debtor is called upon to pay will equal, approximately, the amount which he borrowed. There will not so often be the changing relationship between he who pays and he who receives payment. With the fall in the price level, the face value of debt in the United States is possibly now equal to the total national wealth, although, when the debts were incurred, it represented not more than half of the national wealth. Unless the price level is raised, it is clear that a large proportion of the face value of this vast volume of indebtedness cannot be paid.

The third speaker of the evening was Dr. W. W. Cumberland of Wellington and Company who dealt with "Imprudent Investment." He opened by quoting Governor Roosevelt's contention that public utility rates and securities issued by public utility enterprises ought to be based upon prudent investment, and raised the question as to what is to be considered such. Dr. Cumberland expressed the view that one of the important causes of the depression was failure to handle capital properly. When prices are rising, almost any kind of a loan is safe. When prices are falling, the debtor loses because of the increased burdensomeness of the debt, but the creditor does not always gain because, in many cases, the debtor is unable to pay. Dr. Cumberland laid down the principle that no loan is to be considered productive unless the asset established is greater in value than the money borrowed.

The lender needs security plus a satisfactory yield on his investment. The greater the burden of debt, the less the security. According to Dr. Lionel D. Edie, the total burden of debt in the United States in 1912 amounted to about 27 per cent of the national wealth. If the average rate of interest on this indebtedness was 5 per cent, the total interest was a charge of 8 per cent on the national income. In 1932, however, the total debt had increased to something like 47 per cent of the national wealth and, to pay 5 per cent interest on this amount, requires some 15 per cent of the national income.

Our states and municipalities have borrowed huge sums for public improvements. These improvements have, in many cases, greatly enhanced the value of the property adjoining. Frequently, they have not correspondingly increased the money income of holders of such property. In these cases they have not created income commensurate with increasing interest charges. The increase in value of the property is, therefore, merely an illusion of security behind the loan.

Many of the investments made during the recent period of prosperity are hard to justify. Railroads expended vast sums on improvements made in an effort to offset the effects of competition, but, in many cases, this expenditure has proved unproductive. A large proportion of the earnings ploughed in by leading industrial corporations has yielded no adequate return, but has merely resulted in excess capacity. In such cases, both stockholders and the general public would have been better off if the earnings had been distributed as dividends instead of ploughed in. In general, when a proposed investment by a corporation is not

such that financing can be obtained from the money market, the probabilities are that it is unsound and that corporate funds should not be placed therein.

Mr. Cumberland felt that the view generally held that debt is a normal part of business finance is erroneous. Debts ought to be incurred only in times of emergency, and such debts should be paid off in the next period of prosperity. Loans should have no longer life than the purpose or property in connection with which they are made and all loans should carry rigorous amortization provisions. Were this policy always followed, the danger of having serious depressions would be greatly lessened.

The last regular speaker on the program was Mr. Horace Bowker, President of the American Agricultural Chemical Company. The topic of his address was, "Agricultural and Industrial Stability." He began by stating that the stability of industry is dependent upon the purchasing power of the common people. We cannot have business recovery until consumers are able to buy. One of our greatest difficulties is that the purchasing power of the farmers has been unduly low. When the prices received by the farmers for the things they bought fell without a corresponding reduction in the prices of the goods which they purchased, trouble for industry was in store. The most hopeful feature of the present situation is that the gap between farm prices and the prices of urban products is no longer growing larger.

Mr. Bowker expressed the view that the only way in which to align farm incomes and urban incomes is to increase the efficiency of the farmers. The farmer can make money only if he can reduce costs sufficiently to enable him to compete in the world markets. The surest way in which to reduce costs is to use more fertilizer. Careful investigation shows that those farmers who use an adequate supply of fertilizer are able to produce at not more than half or two-thirds of the average cost per unit of output. For two years farmers have been "soil-mining" to an unprecedented degree. This means lower yields per acre, higher unit production costs and a further decrease in farm purchasing power. Good business policy demands that the usual amount be not diminished, but greatly increased. The Federal Government ought, therefore, to loan to the farmers at least one hundred millions of dollars to be used exclusively for the purchase of fertilizer. Such a loan would be reflected in a decrease in the cost of growing crops and a corresponding increase in farm purchasing power. Such a loan would be self-liquidating within six months after it was made. Enhancement of the farmers' income would mean that he would buy more from the city and hence would help the urban business man.

The discussion was led by Merryle S. Rukeyser, financial writer, and J. Herbert Leighton of the Bush Terminal Company, and was followed by remarks from the floor by a number of speakers. Mr. Leighton raised the question as to whether a Federal loan to farmers, for the purpose of buying fertilizer, would not result in overproduction of farm produce and make the situation worse, rather than better.

Mr. Leighton also mentioned the fact that it is now the fashion, rightly enough, to criticize those statisticians who, in 1929 or earlier, drew lines from the trough of 1921 to the peak then attained, and extended these lines upward into the future

as if they were "trends." Is it not now equally the economic fashion of the day, he asked, to draw lines (verbally) from the peak of 1929 to the summer of 1932 and extend them downward into the future as if they were "trends,"—a fashion perhaps exemplified in some of the evening's addresses? In discussing long-range economic tendencies, the fact that such "trend projection" is verbal and implied rather than graphic and clearly explicit, makes it all the more imperative to be on our guard in a period of uncertainty to differentiate so far as we can between trend and cycle.

The meeting adjourned.

WILLFORD I. KING, *Secretary*

THE COST OF GOVERNMENT IN THE UNITED STATES AND ITS MEASUREMENT

A dinner meeting of the American Statistical Association was held on Tuesday evening, November 29, 1932, at the Hotel Woodstock, 127 West Forty-third Street, New York City. Eighty-seven persons were in attendance. The general topic under discussion was *The Cost of Government in the United States and Its Measurement.*

Professor Thomas S. Adams of Yale University presided. He opened the meeting by saying that, if the credit of the Federal Government is to be maintained, it is necessary to convince a doubting world that we are both able and willing to balance the budget *not* at once, but within a reasonable future period. The problem is as much psychological as financial. Psychologically speaking, the fiscal year 1935 is early enough, provided the financial world is convinced that a real balance will be achieved by that time.

Financially speaking, the short session of Congress should be devoted to the difficult task of reducing public expenditures. The demand for economy is now stronger than it has been at any time during the last fifty years. There is a real question, however, whether any material reduction of expenditures can be achieved. Expenditures can be reduced materially only by decisions of policy. Cheese-paring economies are well worth while in themselves, but they do not materially relieve the strain upon the taxpayer. Such decisions of policy mean cutting down veterans' allowances, appropriations for special construction, grants for education and highways, special appropriations for agriculture and the like. In general, no great reductions in expenditures are to be expected, much as they are to be desired.

From the standpoint of policy, however, the question of balancing the budget and imposing new taxes should be postponed until we know whether Congress and the American people have the resolution to cut federal expenditures materially during the fiscal years 1934–35.

The first regular speaker of the evening was Dr. Roland P. Falkner, who spoke on the subject "Balancing the Federal Budget." He called attention to the fact that the subject might be treated from the viewpoint of international relations, from the viewpoint of the economic effect of huge government issues of bonds, or from the viewpoint of the tax expert. He stated that he would consider it simply

as a statistician and try to answer three questions: (1) what the deficit was, (2) how the deficit came about, and (3) what were the prospects of its reduction or elimination.

The deficit in the year 1930–31 amounted to 903 million dollars, in 1931–32 to 2,558 million dollars, and in the current fiscal year appears to be accumulating at about the same rate as in the previous year. The deficit implies a comparison over a more or less extended period of time, usually a fiscal year, and one cannot argue from the events of the first four months of the current fiscal year to the results of the year as a whole, since so much depends on the distribution both of receipts and expenditures within the fiscal period.

Considering the Federal finances from the standpoint of annual or semi-annual operations, the deficit did not appear in the Federal budget until January, 1931. Up to that time the shadow of the depression had not fallen upon the government revenues, which continued to rest largely upon taxes based upon the prosperous incomes of 1929. When the deficit came, it was clearly the result of business depression and not of Congressional ineptitude. Expenditures for 1930–31 were authorized by the Congress of 1929–30, while those for 1931–32 were authorized by the short session Congress which terminated March 4, 1931. When the latter Congress acted, no one could foresee the extent to which business and hence government revenue would decline, and Congressional leaders cannot be legitimately blamed for lack of foresight.

The speaker showed that the increase of expenditures in 1931–32 was attributable in large part to measures taken to combat the depression. Looking to the future, he suggested that, when the time comes that such emergency expenditures can be omitted we should return to approximately the pre-depression level of expenditure. He seriously doubted whether this expenditure of approximately four billion dollars could be materially reduced. Of this sum, approximately one billion dollars is for debt charges which cannot be reduced. Approximately another billion goes to the veterans, and the speaker emphasized the improbability of the success of any effort to reduce the sums heretofore granted to the beneficiaries of veteran relief legislation, though holding that the time had come to check the rapid growth of expenditure for this purpose. Any reduction of expenditure must, therefore, be confined to the remaining two billion dollars, which he characterized as the operating expenses of the government. Temporarily, such operating expenses could be reduced, but not without a marked decrease in the output of governmental services of one kind and another. While the pruning knife might be applied temporarily and the expenditure for government services decreased by decreasing those services, the forces which have led to the expansion of government continue to exist and will sooner or later bring them back into existence. It is more likely that, if anything can be done in the fiscal year 1933–34 to balance the budget, it will be rather through increased taxes than decreased expenditures. Balancing the budget may be a means of promoting the return of prosperity, but a permanent elimination of the Federal deficit is not to be expected until the normal expenditures of the government can be met from the proceeds of normal taxation.

The second speaker of the evening was Mark Graves, Director of the Division

of the Budget of the State of New York. He spoke on "Balancing the State Budget." Mr. Graves began by pointing out that New York State is in a different position from the Federal Government in that the budget must be balanced every year, for such a balance is demanded by the constitution of the State.

The securing of a balanced budget has been rendered difficult by the fact that, during the last year, State revenues have shrunk by 54 millions. This shrinkage is due primarily to the depression, for the taxes upon which State revenues depend are largely affected by business prosperity. For example, the income tax in 1929 yielded 40 millions of dollars. In 1932, though the rates are higher, the yield will be less than half that amount. There has also been a great shrinkage in the revenues derived from stock transfers. The State tax on realty was abolished in 1928. This abolition eliminated one reasonable stable source of steady income. While the depression has caused a great shrinkage in State revenues, expenditures have tended to grow by leaps and bounds. One of the chief of these expenditures is State aid to local governments. Out of the money collected by the State, 50 million dollars is immediately distributed to the various localities. Furthermore, the State subsidizes local schools, roads, health services, reforestation, and old age relief. The amount of aid given to localities by the State for these purposes has risen, in the last ten years, from 40 to 121 millions of dollars. Under the provisions of existing statutes, such State aid will be increased to 135 millions of dollars next year.

Another prime difficulty in balancing the State budget arises from the fact that the people of the State persist in voting in new bond issues, and these open issues naturally increase the interest charges. In recent years, bonds have been voted for the bonus to soldiers, and for State hospitals, parks, prisons, and the elimination of grade crossings. In the recent election, 30 millions more of bonds were voted for unemployment relief. As a direct result of this policy, debt charges are rising from 25 millions this year to 32 millions next year.

After the State has distributed money to localities and has paid the required debt charges, it must then meet its own current expenses. It supports 81 thousand people in institutions at a cost of $430 per person per annum. Appropriations have been reduced until only six cents is allowed for each meal. It seems difficult to cut the figure lower. However, these institutions cost 38 million dollars a year. Seven colleges and other schools operated by the State are attended by sixteen thousand students. Their education costs 6 million dollars per annum. Three million dollars are spent to operate the barge canal. It produces no revenue, for the law provides that its services shall be free to the public. It takes 9 million dollars each year to keep the highways in repair. Two millions are spent on the legislature; 4 millions on the State courts; building upkeep requires 3 millions; 14 millions are spent for new buildings, new highways and other improvements. This leaves 29 millions to cover the cost of all other departments of the State government. Apparently the only feasible place to make any large reduction in State disbursements is to reduce the amounts paid to local governments. Unfortunately such reduction is not likely to be of material benefit to the taxpayers for the local governments as well as the State government are in financial difficulties. If the State stops collecting these

revenues for them, they will doubtless levy them themselves. However, if the State does not reduce disbursements to localities, an increase in State taxes seems inevitable.

The third speaker of the evening was Gaylord C. Cummin, President of the Municipal Securities Service. The subject of his address was "Balancing the Municipal Budget." He began by pointing out that, in the past, the usual custom has been to decide how much money the municipality needed and then to determine what taxes must be levied in order to cover this amount. At present, however, this policy is breaking down and municipalities are being forced to ask first how much taxes they can collect and later to determine what to do with this limited revenue.

The first thing that municipal authorities usually do when confronted with financial difficulties is to look for some method of shifting taxes which will produce more revenue without increasing the burden resting upon the citizen. Such a search is much like looking for the pot of gold at the end of the rainbow. The only way to reduce the burden upon the taxpayers is to cut expenses.

Municipal authorities usually believe it essential to balance the local budget. However, they are often satisfied with a nominal rather than an actual balance. In many cases, they do not hesitate to over-estimate receipts or to under-estimate expenditures. Later on they borrow to meet the resulting deficit.

Of course we all want economy in those phases of government in which we are not interested. However, we object strenuously to reducing either our own salaries or those of our friends, and we certainly do not desire to have any of our friends dismissed from public positions. Yet, the only practical way in which most municipalities can reduce expenses is to reduce the amount paid out in wages or salaries.

Even when a city sincerely desires to reduce expenses, it frequently is prevented from doing so by mandatory laws passed by the legislature fixing the number of employees and their respective salaries. Most of these laws were passed in the hope of preventing extravagance. Now they also prevent economy.

Another hindrance to an economic program is our system of checks and balances in government. Responsibility is much divided. Each officer in a department strives vigorously to place upon an officer in some other department the responsibility for reduction in payroll, and avoids taking on responsibility for such unpopular measures. As a rule, public officials are interested primarily in trying to give the public what it wants. The public usually wants more expenditures rather than less.

The most powerful force which, at present, is working toward a reduction in municipal expenditures is the refusal on the part of investors in municipal securities to buy the bonds of those municipalities having unbalanced budgets. In those cities in which the situation is so bad that borrowing is imperative, the views of these potential investors command real respect.

In introducing the next speaker, Professor Adams called attention to the fact that, in some cases, very remarkable reductions may be made in municipal expenditures without disastrous results. For example, he cited the case of one municipality which recently reduced its expenses from $1,400,000 to less than

$400,000 per annum, without seriously impairing the work of the governmental machinery.

The discussion of the papers of the preceding speakers was opened by Professor Robert M. Haig, Professor of Political Economy at Columbia University. He stated that the nominal Federal deficit will probably amount to between five and five and a half billions of dollars by June 30, 1933. Of this amount, however, some one and a quarter billions represents reduction of the public debt and one-half a billion has been invested in the Reconstruction Finance Corporation. How much of this investment will eventually be recovered is, of course, problematical. It seems probable that capital outlays may account for another billion dollars. The true deficit, then, up to June 30, 1933, will probably be in the neighborhood of from two to two and a half billions. In proportion to the wealth of the United States, this is a relatively small amount: certainly the credit of the Federal Government is still unimpaired. That such is the case is illustrated by the fact that the interest rates on its securities are abnormally low, although, at the same time, municipalities with unbalanced budgets must pay high rates of interest for loans.

The policy of letting the deficit continue until the end of the depression may be viewed with equanimity if expenditures can be kept within reasonable bounds. The danger is that Congress may become reconciled to the existence of an unbalanced budget and spend money recklessly.

The probabilities are that the budget will be balanced by levying new taxes rather than by decreasing expenses. Professor Haig was of the opinion that an income tax reaching down to the lower levels of income would be preferable to a sales tax, because of the regressive character of the latter. A logical system of taxation would provide that, in the case of variable taxes, a considerable proportion of the revenues in good years be held in reserve to be used to cover expenses in bad years. It is, however, difficult to put such a system into practice.

Professor Haig expressed the view that there was much more possibility of making substantial reductions in expenditures in New York City than in the case of the Federal Government. He saw no reason for not placing municipal services such as the subway on a self-sustaining basis.

After a brief discussion from the floor, the meeting adjourned.

WILLFORD I. KING, *Secretary*

PROGRESS OF WORK IN THE CENSUS BUREAU

CENSUS OF INSTITUTIONS

The census of defective, dependent, and delinquent classes in institutions is one of the more important of the decennial inquiries which the Census Bureau makes in the period between the decennial censuses of population. In this inquiry, which is to cover the calendar year 1933, it is proposed to include the following classes:

1. Sentenced prisoners in State and Federal prisons. (This is now an annual inquiry.)
2. Sentenced prisoners in county and municipal jails and workhouses.
3. Juvenile delinquents in reformatories and similar institutions.

4. Patients in hospitals for mental disease. (This is now an annual inquiry so far as concerns State institutions; the number of institutions under private and local governmental supervision, to be added for 1933, is relatively small.)
5. Inmates in institutions for the feeble minded and epileptic. (This is now an annual inquiry so far as concerns State institutions; the number of other institutions is relatively small.)
6. Paupers in almshouses.
7. Inmates of institutions, other than almshouses, for the care of adults.
8. Inmates in institutions for dependent children.
9. Children under the supervision of child-placing organizations.

The inquiry made 10 years ago, covering parts of the years 1922 and 1923, included certain other types of institutions, namely, general medical hospitals, dispensaries, humane societies, day nurseries, and certain detention homes and other private agencies working with juvenile delinquents. For 1933 it has been proposed that the inquiry be limited in the main to those institutions which represent the more or less permanent place of residence of certain classes of the population; hence the omission of the types of institutions just named.

By reason of limited appropriations it will probably be necessary to restrict also the scope of the inquiry for some of the institutions which are canvassed, as compared with that of 1922–23. The attempt was made then, for example, to obtain an individual card record for each pauper in an almshouse at the beginning of the year or admitted during the year. It seems likely under present circumstances this inquiry will be confined to a general report showing the movement of population during the year for each institution as a whole, with a very simple classification of the inmates in the institution on a given date.

Three of the nine classes of institutions for which the decennial census is projected are covered wholly or in part by an annual inquiry which will be continued for the year 1933. For State and Federal prisons the decennial census will differ very little from the annual census. For the insane hospitals the inquiry addressed to the State institutions will be expanded somewhat from the annual basis, mainly through the collection of individual reports in place of the tabulated returns made each year; and this inquiry will be extended to cover hospitals for the mentally diseased under other than State direction. Similar changes will be made in the regular program for the institutions for the feeble minded and epileptic.

The inquiry with respect to juvenile offenders in reformatories will follow in general the plan of the annual inquiry for the State prisons, with proper modifications to suit the conditions obtaining in the institutions for juvenile offenders.

The most extensive single inquiry in the decennial census of institutions will be that relating to prisoners in county and municipal jails. In this inquiry it is proposed to obtain individual returns for prisoners in the institution at the beginning of the year, for those admitted and discharged during the year, and for those remaining in the institution at the end of the year, with a classification by sex, color, nativity, age, offense, sentence, number of prior commitments, time served, and method of discharge—whether by expiration of sentence, payment of fine, parole, pardon, or otherwise. One schedule has been devised to carry all of this information, and in order to facilitate the collection of the data, it is proposed to distribute the schedules at the beginning of the year 1933 and request that

they be filled out from day to day as the prisoners are discharged. This will leave for completion at the end of the year only the schedules for those prisoners in the institution at that time, a relatively small number as compared with the commitments and discharges for the year.

For the almshouses and other classes of charitable institutions it is proposed to obtain, as already indicated, a summarized schedule for the institution, with no attempt to get individual returns for population or commitments. For these institutions the schedules will not be sent out until the latter part of 1933, since they cannot be filled out until the completion of the year which they are to cover.

One important change in the general method of procedure for the institutional census, as compared with that of 1922–23, is that no payment is to be made to the institutions or their employees for filling out the schedules. Experience with other inquiries makes it seem reasonable to expect that satisfactory returns can be secured on the new basis. It has been difficult to arrange rates of payment for such schedules which are fair to all concerned, by reason of the widely differing conditions in each institution; and in many cases the actual expense of making the remittance in the form of a Treasury draft for the small amount due an individual has exceeded the amount of the remittance itself. Further, for most of the institutions the schedules requested for 1933 will be far simpler than those of 10 years earlier and can be filled out in a fraction of the time then required.

The work so far accomplished on the decennial census of institutions includes the printing of the schedule for county and municipal jails; the preparation of the mailing lists for these institutions; and the general revision of the schedules for the annual inquiries which are to be expanded for the year 1933.

MISCELLANEOUS NOTES

The New York Supper Discussion Meetings.—The Uptown and Downtown Luncheon Meetings of the Association, held during June and July of this year, were so successful in providing brief gatherings consisting of short "idea talks" followed by intimate and pertinent discussion of these ideas from the floor, that it was decided to revive this type of meeting in the fall. The Uptown and Downtown Committees felt, however, that many interested persons were kept from these meetings by the necessary shortness of the noon period, as well as by business engagements during the day.

It was decided, therefore, to change these two luncheon meetings each month to a single supper meeting each month, this latter to alternate in time with the regular dinner meetings of the Association. The essential features of the luncheon meetings will be preserved in these new supper meetings: brevity of the stated talks and discussions, extensive ensuing discussion from the floor, popular prices of admission, "leave early, if you must, without prejudice," and supper (not a dinner) served unostentatiously during the discussion period.

The first Supper Discussion Meeting was held on Monday, November 14th at 5:30 p. m., in the main downstairs dining room of Busto's Restaurant, 11 Stone Street. Mr. Leon Henderson of the Russell Sage Foundation presided. The Committee was fortunate in obtaining Dr. Leo Wolman as principal speaker on the subject "Public Budgets and the Relief Program." Both at Columbia and the National Bureau of Economic Research, Dr. Wolman has made authoritative studies on this subject.

He spoke for about 15 minutes. The discussion, presenting other points of view, was opened by Mr. Arthur Gayer, of Barnard College, and the National Bureau of Economic Research, and Mr. Arthur Dodge, of the Regional Banking and Industrial Committee. Each of these gentlemen talked for 10 minutes. They were followed by discussion from the floor.

The Albany Chapter.—The Albany Chapter is conducting again this year classes in statistics. Dr. David M. Schneider of the New York State Department of Social Welfare is responsible for the class in elementary statistics. Mr. Sidney W. Wilcox of the New York State Department of Labor is meeting with the class in advanced statistics. The enrolment is approximately 40 and consists mostly of state employees.

The Chicago Chapter.—The Chicago Chapter held its first dinner meeting of the 1932–33 season on Friday, October 14, with about 50 members and guests in attendance. The topic of the evening "An Analysis of the Personal and Business Failures in the Chicago Region" was given by Professor John H. Cover of the School of Business, University of Chicago. For the past two years, Professor Cover has been the director of the Survey of Business Adjustment, which has been conducted jointly by the University of Chicago with the United States Department of Commerce. In this capacity he made a case and statistical analysis of 1,800 personal and business failures and to the methods of rehabilitation such as bankruptcy, receivership, and creditor assignment. He also made a study of the efforts that are being made to keep business solvent, such as creditor management, and of the way the liquidated cases have rehabilitated themselves. In his introductory remarks he pointed out that there is a lag between the number of failures and business conditions, due to creditors being loath to hasten the process of liquidation; also, that the low point of failures occurs in August or September and the high point in January. Among the causes of business failures he cited (1) neighborhood conditions, which include closing down of plants, bank failures, and unemployment among customers; (2) chain store competition; (3) excessive overhead, which includes principally fixed costs, excessive withdrawals for personal use, and rental; (4) lack of business experience; and (5) lack of capital with which to operate after the business has been opened. The principal causes of personal failures he gave as (1) living beyond income; (2) former business debts; (3) speculation, which includes that in stocks, real estate, and home; (4) signing personal notes; (5) unemployment; (6) part-time employment; (7) illness in family; and (8) illness of bankrupt. Professor Cover quoted much interesting data on concentration of failures in certain sections of the city, the per cent of unemployment in these sections, rents paid, and nativity of the population. Among other things, he stated that the statistical methods employed showed no correlation between the causes of business failures and business conditions; in consumer areas, there was no correlation between the increase in unemployment and personal bankruptcies. In studying the possibilities of rehabilitation, two economic conditions must be faced: price stabilization and security of employment. In the business group, measures of fitness are needed before allowing the establishment of a business; there must be some measure and control of personnel equipment—perhaps a license; and an adequate credit investigation is needed, one that will not only take cognizance of net sales, but also will furnish an adequate gauge of the amount of credit extension to be allowed. A fourth need is coöperative management. From the consumers' standpoint, there should be (1) a development of consumer credit at reduced rates; (2) state medicine; and (3) a consumer coöperative movement. There

is also need of a much less formal method of liquidation than bankruptcy provides, and the elimination of a large group of practising lawyers.

On Tuesday evening, November 22, Mr. Donald R. Cowan, Economist of Swift and Company and instructor in marketing analysis at Northwestern University, gave us the interesting results of a three-year study of wholesale marketing operations to determine the comparative profitableness of selling large and small dealers, different dealer types, and various products. Through the free use of charts, he illustrated how the law of diminishing returns is encountered in selling efforts, coverage of territory, and the number of products handled. Covering too much territory and too many dealers, duplicating selling and advertising efforts, and attempting to sell too many products, were among the major problems encountered in the study. Both statistical and accounting methods were used in the study, so that the result obtained was a rare amalgam of theory and practice.

The Cleveland Chapter.—Miss Mildred M. Hickman, Placement Supervisor, Cleveland Board of Education, was the speaker at the October meeting of the Business Statistics Section of the Cleveland Chapter. Her subject was, "Statistics as an Aid to Education." The talk was illustrated with some very interesting data and charts.

The group reviewed the annual conference of the Harvard Economic Society at its November meeting. The discussion was led by Mr. J. B. Anderson of the Cleveland Federal Reserve Bank and by Mr. B. B. Smith of the Cleveland Trust Company.

An enlightening talk on the work of the Reconstruction Finance Corporation was given at the December meeting by Mr. F. S. Callandar, assistant manager of the Reconstruction Finance Corporation in Cleveland.

The Los Angeles Chapter.—On Wednesday, October 19, 1932, at a dinner meeting, Dr. John Park Young of Occidental College, an authority on public finance, gave his views on the effects of cancellation of World War debts, his subject being "The Financial Interests of the United States." Dr. Young claimed that with respect to South American loans, financial interests in the United States with an eye to the profits from commissions to be earned, loaned more to Latin American countries than their needs justified and beyond their capacity to pay at maturity. Consequently many issues of Latin American bonds will be defaulted or refunded at less than face value with losses to the American investor. He contended that European nations for the most part insist on tying together reparations and World War debts. They conceive, thereby, the idea that they may shift their responsibility for their war debts to the Germans who are generally expected to pay these debts. It is the claim of the cancellationists that the war debts are based upon war time values for commodities and that these work a hardship upon the present ability to pay. While this may be more or less true, in general such is not the case inasmuch as the original debts have been scaled down to approximately the present level of commodity prices. All of these nations by proper financial management and the reduction of certain other expenditures, particularly armaments, would be able to meet these obligations. For various political reasons, principally because they wish to maintain political security they will refuse to do this. The United States Government, unless it is able to collect these debts from its European debtors must pay for its own obligations through taxation of its own citizens. The private debts of the European states, municipalities and corporations are mostly all short term note obligations and have no connection with intergovernmental debts although European argument tends to confuse the two. In all likelihood these will be met at maturity because they are not as complicated as

the intergovernmental debts nor are they befogged with political ramifications. Dr. Young believes that the intergovernmental debts will never be completely paid, with the result that the American taxpayer must necessarily shoulder the burdens of the cost of the World War.

At a dinner meeting on Tuesday January 3, 1933, Mr. M. H. Jemsen of the International Smelting Company of Salt Lake City spoke on "Silver and its Relation to World Finance and Money." Mr. Jemsen outlined the growth of the need for money as a medium of exchange and the invention of credit as the supply of gold and silver became inadequate for the needs of world trade. He further presented reasons why silver is best suited to the monetary needs of the backward nations. Their governments are not sound enough to produce a currency system which will maintain confidence to operate successfully, nor is the annual per capita income large enough to be easily measured in gold. With silver, however, this yearly income is easily observable as a measure of wealth. One of the weaknesses of gold as a basis for an international money is that because of its rarity an individual, a group of individuals, or a nation may sterilize by withdrawing it from the world markets where it acts as a basis for credit. When such sterilization occurs, a liquidation of values follows with a resulting depression. Further sterilization of gold is brought about through hoarding. This process may continue to the point where gold no longer acts as a basis for credit with the result that another commodity is sought as a basis for credit. It is a belief of some silver producers that this may eventually come about and it is hoped that silver will be used as a money basis.

The Pittsburgh Chapter.—An unusual opportunity to hear first-hand discussion of European conditions was offered at the luncheon meeting of the Chapter held at the Harvard-Yale-Princeton Club, Thursday, October 27. Mr. G. E. McLaughlin, of the Bureau of Business Research, University of Pittsburgh, who had just returned from a year's residence in Germany, discussed the economic and political situation in that country. Dr. R. J. Watkins, who had just returned from a four months' tour of Europe, presided at the meeting and led the discussion. The annual forecasts were presented, covering the twelve months beginning with October.

The November meeting was held on Wednesday, the 23rd, at noon. Mr. F. F. Stephan, Director of the Bureau of Social Research, spoke on "An Analysis of Census Data and Their Suggested Uses."

The final meeting of the year was held on Thursday, December 22. A most interesting discussion on the war debt problem was led by Professors Marion K. McKay and Francis D. Tyson, Professors of Economics of the University of Pittsburgh, before a representative group of approximately fifty engineers, economists and statisticians.

Dr. Marion K. McKay's topic was "The Background and Present Status of the War Debts." He analyzed the original debt figures and the statistics of the present funding arrangements nation by nation, made on the basis of estimated capacity to pay, up to 1925. He argued the necessity of sound scaling down the debts in keeping with the fall in the price levels, which has increased the burden of debt payments by about 40 per cent. He suggested that Mr. Hoover's plea for a new funding commission was belated.

Professor Francis D. Tyson's topic was "A Formula for War Debt Settlement." He stated that the problem was now a political, and not an economic one. "The economic evidence is in; our economists and most of the bankers have known since Versailles that the vast sums of reparations and debts could not be paid. The depression revealed the fiction of payment with the ending of our loans to Germany."

Professor Tyson pointed out popular fallacies on the issue: (1) There is no choice between receiving in full, or scaling down the debt, as congressional utterances would indicate. (2) Senator Borah's promise of arms reduction in return for debt reduction is quixotic. (3) Reduction is not only necessary to the allies, but is vital to our own interests. Default is the sole alternative, and it may endanger the structure of commercial debts, and further impair international trend and finance. (4) If possible, we must get debts and reparations, which are inextricably connected both economically and politically, out of the way before the World Economic Conference meets. That conference must deal with the vast problems of trade barriers and monetary stability with the resumption of foreign investment. A simple issue like the debts should be solved first.

Professor Tyson preferred finding a formula of settlement by State Department negotiations, since approval of a new fund commission by Congress seems now impracticable. He suggested the applicability of the Lausanne reparation settlement to the debt issue. This would permit an immediate capital settlement by the issuing of bonds in the international money markets. Those who insist Europe can pay could not logically contend such bonds could not be floated. The proceeds could be used for investment to aid foreign trade revival for the United States. Such a formula could be interpreted by politicians as no surrender on the debt issue, but would really mark the end of the request for impossible payments and take the first vital step toward world economic recovery.

The San Francisco Chapter.—The twenty-fifth dinner meeting of the San Francisco Chapter was held on Thursday, October 20, 1932, at the Bellevue Hotel in San Francisco. This being the annual meeting, the report of the District Secretary was presented and approved. Officers elected for the coming year were H. R. Tolley, Director of the Giannini Foundation, University of California, President; B. F. Haley, Department of Economics, Stanford University, as Vice-President; and Robert W. Bachelor, Federal Reserve Bank Building, San Francisco, nominated to the national Association as District Secretary.

The topic for the evening was "A Critical Appraisal of Current Measures of the General Price Level and of the Value of Money." The speakers were H. J. Stover and Elmer Braun, both of the Giannini Foundation of Agricultural Economics, University of California. The discussion was presented in three main divisions: 1. The relation of the general price level to the value of money; 2. Comparison of current indexes of the general price level such as the Bureau of Labor Statistics wholesale price level, retail price level, cost of living index, and Snyder's index of the general price level; 3. Relation of general price level to the prices of individual goods.

Dr. Stover discussed the relation of the general price level to the value of money. He reviewed the past and present views as to the value of money, and discussed the early attempts to measure mathematically changes in prices and the value of money. He reviewed the controversies as to the statistical methods to be followed, the kinds of averages which were appropriate, and the selection of the price quotations entering into the index numbers. He then discussed the value of money to the individual, based upon the individual budgets and standards of living, and pointed out the dangers of using a budget based upon the distant past. Changing qualities of the same article, the greater durability built into products, and other factors which make the construction of index numbers hazardous were pointed out. Mr. Braun made a detailed comparison of the components of each of the leading price indexes currently published. He discussed the purpose of each type of index, as outlined by the agency

constructing and publishing such information. He brought out the differences between indexes and the reasons therefor. He warned against using an index for a purpose for which it had never been intended.

The two speakers then jointly led a discussion on the relation of the general price level to the prices of individual goods. Recent experience in price analysis was reviewed, especially in relation to California agricultural commodities. Other topics were touched upon.

United States Bureau of Labor Statistics.—A survey of unemployment-benefit plans and of unemployment-insurance systems in the United States and foreign countries during 1931 and 1932 was made by the Bureau, and the information obtained was published in the *Monthly Labor Review* for December, 1932, and January, 1933. This supplements the study made in the spring of 1931 and published as Bulletin No. 544.

A comprehensive inquiry was made by the Bureau as to the extent to which the 5-day week has been permanently adopted in American industry. One part of the study summarizes data for 44,025 establishments having 3,848,349 employees and representing 102 industries or industry groups; the other part shows the extent to which the 5-day week is provided for in collective agreements between employers and organized labor, a total union membership of 595,367 being represented.

A study of the value and kind of goods produced by convict labor in the United States is in progress, the field work being practically completed. The report will show the systems under which the goods are produced and disposed of, together with the number of convicts employed.

An analysis of elapsed time in building construction in 14 cities was completed in the latter part of 1932. The results, published in the *Review* for January, 1933, show the length of time elapsing between the date of issuance of a building permit and the date work was started on the building; the time elapsing between the date work was started and the date the building was ready for occupancy; and the number and per cent of lapsed permits.

The Bureau is continuing its investigations of the effects of technological changes upon employment, the automobile-tire industry, the slaughtering and meat-packing industry, and road building being reported upon in recent issues of the *Review*. A digest of the material on technological changes and labor displacement, published during the past several years by the Bureau, was given in the November *Review*.

Data on wages and hours of labor in glass manufacture, in bituminous coal mining, and in police and fire departments of the larger cities, and on wages and hours of common street labor hired by cities, are being collected. Summary reports on wages and hours during 1932 in the hosiery and underwear industry and in the clothing industry have been published.

Other topics which have been the subject of special study and of articles in the *Review* included the legal restrictions on the hours of labor of men; and laws regulating hours of labor of motor-bus drivers; the period of waiting time required under workmen's compensation laws; costs of dwelling units in various cities, as shown by building permits; and workmen's compensation and other labor legislation of 1932.

Women's Bureau, United States Department of Labor.—The Bureau has published a study made by students of the Bryn Mawr Summer School of changes in their own living conditions forced by unemployment during the 12 months preceding the summer of 1932. The survey covers 109 students, from 17 states and distributed among the major industrial groups with over half in some branch of the clothing trades.

A report on the installation and maintenance of toilet facilities in places of employment has been completed by the Bureau and constitutes the third in a series of handbooks on industrial standards. The bulletin discusses factors of importance in the provision of suitable toilet facilities. The various types of statutes, rules, orders, and recommendations in effect in the states are classified in regard to method and scope.

A report has been published recently by the Women's Bureau on the employment of women and the hazards of lead exposure in vitreous enameling. Forty-seven plants, practically all making stoves, were visited, and 686 women then or recently employed were interviewed in their homes. The survey was made with the assistance of Dr. Alice Hamilton, assistant professor of industrial medicine at Harvard Medical School. The U. S. Bureau of Standards coöperated by analyzing samples of enamel from firms supplying such samples where the lead content was unknown.

The Pennsylvania Department of Labor and Industry.—The Department has begun a study of low wages and long hours of labor in the textile and clothing industries. The results of this survey will be available about the end of March.

Beginning January 1, 1932, new standards for statistics of public employment offices were put into effect. These revised standards are to be effective only until the final recommendations of the American Statistical Association's Committee on Governmental Labor Statistics are made. The plan adopted on a temporary basis, however, does provide consistent classifications and definitions for the recording of applications, openings, and placements not hitherto available.

The Department has begun the collection of monthly employment and payroll information from banks, insurance, and real estate firms in Pennsylvania. Initial returns indicate that the Department will be able to provide information for this "white-collar" group for more than 600 firms employing approximately 17,000 workers.

The State Committee on Unemployment Reserves will present its recommendations to Governor Pinchot during March.

The Commission on Compensation for Industrial Disease also expects to make its recommendations to the Governor in March.

The Brookings Institution.—Since the first of the year the radio program on current economic and governmental problems directed by the Brookings Institution has been as follows: January 7, How Shall We Buy in 1933, Leverett S. Lyon and Mrs. Harris T. Baldwin; January 14, Your Tax Bills, Benjamin P. Whitaker and Richard M. Boeckel; January 21, The Farmer Never Quits, Edwin G. Nourse and Charles G. Ross; January 28, Don't Break the Farmer's Back, Edwin G. Nourse, Benjamin P. Marsh, and Nils Olsen; February 4, What Does Technocracy Offer, Charles O. Hardy and Felix Morley; February 11, Can Public Works Stop Depression, Otto T. Mallery and Isador Lubin; February 18, Financial Reconstruction, Charles O. Hardy and Edwin A. Lamke; February 25, Governmental Reorganization, Lewis Meriam and Miss Ruth Finney; March 4, Problems of the Next Four Years, Lewis L. Lorwin and William Hard; March 11, An American Industrial Policy, Lewis L. Lorwin and Otto S. Beyer; March 18, Can We Afford to be Sick, Lewellyn F. Barker, Harry Moore, and Watson Davis; and March 25, The Transportation Problem, Harold G. Moulton. Six earlier broadcasts in the series were given during November and December, and six additional addresses will be delivered on successive Saturday evenings from April 1 through May 6. To insure informality these broadcasts are presented in the form of

lively discussions and round tables. The addresses are published in pamphlet form and are obtainable from the University of Chicago Press.

Felix Morley, of the Institution staff, will be on leave of absence during March, in order to coöperate in launching the Carnegie-financed public forums in Des Moines. Mr. Morley was one of the first five discussion group leaders selected by the Des Moines Board of Education for this purpose.

Dr. Henry Erdman, Professor of Marketing in the Giannini Foundation of the University of California, is spending a half year's sabbatical leave in Washington, D. C. He is making his headquarters at the Brookings Institution and is spending his time in the study of recent developments in marketing and coöperative organization.

Dr. Tracy E. Thompson, who has been on leave from Ohio State University as Industrial Analyst in the Bureau of the Census, will remain in Washington during the winter months on appointment with the Institute of Economics. Dr. Nathanael H. Engle, who served as Marketing Expert with the Census of Distribution, is now employed on the staff of the Institute of Economics.

In the Institute of Economics the following research projects have recently been brought to completion: Advertising Allowances: A Phase of the Price-Making Process by Leverett S. Lyon; Ten Years of the Federal Intermediate Credit System by Frieda Baird and Claude L. Benner; and American Federation of Labor by Lewis L. Lorwin.

Dr. Laurence F. Schmeckebier of the Institute for Government Research is assisting at the Bureau of Naturalization in the preparation of a detailed analytical report of the statistics on naturalization for the fiscal years 1907–10.

The following are collaborating with H. G. Moulton in the study of the American Transportation Problem, now being prepared in connection with the work of the National Transportation Committee: Frieda Baird, Charles Dearing, Paul David, Wilfred Eldred, Ralph Fogg, Charles O. Hardy, Lloyd C. Hoeltzel, S. Kobe, Ralph L. Dewey, Charles W. Eliot 2d, Edwin A. Lamke, Adah L. Lee, Isador Lubin, Fred W. Powell, Porter R. Taylor, C. Warner Tufts, and Benjamin P. Whitaker.

Personals

Stuart A. Rice, Professor of Sociology and Statistics at the University of Pennsylvania and our Association's new President, has been given a leave of absence for one year from the latter institution during which he is a Visiting Professor of Sociology at the University of Chicago. During the Fall, Winter and Spring Quarters Mr. Rice's schedule includes courses on Introductory Statistics, Scientific Methods in Social Science, Social Effects of Communication and Quantitative Methods in Politics.

J. Frederic Dewhurst, chief of the Division of Statistical Research of the Commerce Department and member of the United States delegation to the preparatory meeting on the World Economic Conference, has left the government service to become associated with the American Iron and Steel Institute in New York. In leaving the department Mr. Dewhurst follows his former chief, Secretary Lamont, who resigned his Cabinet post to become President of the Institute. He was to have returned to the general sessions of the World Economic Conference next Summer with Louis Domeratsky, also of the Commerce Department. Professor Dewhurst was formerly a member of the faculty of the Wharton School of the University of Pennsylvania, and of the staff of the Federal Reserve Bank of Philadelphia.

Obituary Note

Edwin Gruhl, President of the North American Company, died in January of coronary thrombosis at his residence, 975 Park Avenue, New York City. His promo-

tion to the Presidency of the Company last April marked the climax of a continuous service with it that began nearly twenty-one years ago, when he was appointed assistant to the Vice-President. In 1914 he was made Assistant to the President, in 1920 Vice-President, and later the post of general manager was added to his duties.

His entrance into high executive corporative work followed a comparatively brief period of intensive study of public utilities. He at first became a member of the staff of the engineering department of the Wisconsin State Railroad and Tax Commission, and later statistician with the Wisconsin State Railroad Commission. His exceptional ability, of a range beyond the needs of his previous activities, soon manifested itself after he joined the North American Company. At his death he was an officer or director of more than thirty corporations.

Mr. Gruhl was a son of Fred J. and Emma Shroeder Gruhl. He received his B.A. degree from the University of Wisconsin in 1908. In 1924 he married Helen E. Way of Milwaukee, who survives, as does his mother, a resident of Milwaukee.

MEMBERS ADDED SINCE DECEMBER, 1932

Badger, George F., Assistant Epidemiologist, Herman Kiefer Hospital, Detroit, Mich.

Benowitz, Hyman K., Analyst, 304 Greenwich Street, New York, N. Y.

Bowerman, Walter G., Assistant Actuary, New York Life Insurance Company, 51 Madison Avenue, New York, N. Y.

Carlton, Dr. Frank T., Case School of Applied Science, Cleveland, Ohio.

Dulles, Dr. Eleanor L., Instructor, University of Pennsylvania, 3440 Walnut Street, Philadelphia, Pa.

Ellison, Professor John M., Department of Sociology, Virginia State College, Ettrick, Va.

Fink, Hugh W., Department of Statistics, American Telephone and Telegraph Company, 195 Broadway, New York, N. Y.

Gerken, Theodore H., Resident Editor at Pittsburgh for the *Iron Age*, 1319 Park Building, Pittsburgh, Pa.

Hanchett, Dr. D. S., Fieldston School, Fieldston Road, Fieldston, N. Y.

Hobbs, G. Warfield, 3rd, Investment Department, City Bank Farmers Trust Company, 22 William Street, New York, N. Y.

Hutchinson, Edward P., Graduate Student, Department of Biology and Public Health, Massachusetts Institute of Technology, Cambridge, Mass.

Lupinski, Hugo H., Supervisor of Statistics, New York Telephone Company, 1775 Grand Concourse, Room 801, New York, N. Y.

Miller, Edward C., General Supervisor of Statistical Department, Near East Foundation, 151 Fifth Avenue, New York, N. Y.

Miller, Emory T., Statistical Research, Clinton Gilbert and Company, 120 Broadway, New York, N. Y.

Phelps, Gordon, Statistical Department, Ned. Koloniale Petroleum Mij., Soengei Gerong, Palembang, Sumatra, Netherland East Indiee.

Roe, Frederick, Investment Management, 120 South La Salle Street, Chicago, Ill.

Riordan, John, American Telephone and Telegraph Company, 195 Broadway, New York, N. Y.

Schmidt, Dr. Carl T., Charleston College, Charleston, S. C.

Schumacher, Francis X., Section of Forest Measurements, U. S. Forest Service, Washington, D. C.

Schwarz, Ruth, Social Statistician, Emergency Home Relief Bureau, 69 West 47 Street, New York, N. Y.

Stahl, Gustav R., National Industrial Conference Board, Inc., 247 Park Avenue, New York, N. Y.

Timmerman, Willem A., Statistical Department, South African Railways and Harbours, 39, Plantation Road, Auckland Park, Johannesburg, South Africa.

Tufts, Mrs. Edith M., Research Associate, Bureau of Social Research, 711 Wabash Building, Pittsburgh, Pa.

Wilson, Robert L., Analyst, Bell Telephone Company of Pennsylvania, 416 Seventh Avenue, Pittsburgh, Pa.

REVIEWS

Economic Tendencies: Aspects of Pre-War and Post-War Changes, by Frederick C. Mills. New York: National Bureau of Economic Research. 1932. 625 pp.

Professor Mills' book traces the leading economic tendencies which characterized two periods in American history, 1901–1913 and 1922–1929. The work thus falls into two major parts: Chapters I–IV dealing with the earlier period and Chapters VI–IX with the later one. Chapter V summarizes briefly the interregnum from 1913 to 1922. For each of the two periods successive chapters deal with Production, Commodity Prices, Prices and Cost Changes in the Manufacturing Industries, and Other Economic Changes.

The tabular contrast between the two periods which begins the foreword is sufficiently striking to arouse interest. The first was a period of rising prices, the second of almost stationary prices. Per capita real earnings in manufacturing industries rose rapidly in the second period, but fell slightly in the first. The per capita volume of production increased more than twice as fast in the second period as in the first. The prices of common stocks rose eight times as fast in the second period as in the first.

The method of the book is primarily that of statistical description. The author is careful to explain that his "study does not aim at an explanation of the recession of 1929." But the book is not without hypotheses. The chief of these is the concept of stability. Obviously a changing society will alter in many ways: in the nature of the goods consumed, in the relative prices received for different classes of goods, etc. All these changes cause strain and stress. The book is devoted to these changes. "We may hope," says the author, "ultimately to define more accurately than is now possible the limits of tolerance of the existing order in relation to the stresses and strains to which it is exposed."

Since it would be impossible in the limits of a review to describe the contents of a book so large and so full of material, I have selected the first and sixth chapters which deal with Production in the two periods as illustrations of the author's method. Goods are divided into many different classes: raw materials and manufactured goods; farm products and all other goods; raw farm products and processed farm products; other raw products and other processed products; foods and non-foods; foods raw and foods processed; consumption goods and capital goods, etc. For each of these classes an index number of production, the annual rate of change and an index of instability are calculated. Some of these classifications and contrasts have important significance. For example, it is easy to see that with a population growing at the average rate of 2 per cent, an increase of raw American farm products at the rate of only 1.7 per cent would be favorable to the farmers. The farm population is relatively homogeneous. But what is the significance of a difference in the relative rates of growth of the production of processed foods and raw foods? This is to complain, however, of a superabundance of furnished material. The author might very well reply that at some later date importance in someone's theory might attach to just such a

distinction. Extremely interesting differences in the production movements of different classes of goods in the two periods emerge from the discussion. The two chapters on Commodity Prices follow in general the same classification as those on Production.

In the two chapters on Prices and Cost Changes in the Manufacturing Industries, the author has used the Census of Manufactures to compute some new and highly interesting figures as to changes in labor costs and overhead costs and profits. It appears that from 1899 to 1914 labor costs per unit of product (in terms of a commodity standard) declined 16 per cent and overhead costs plus profits declined 22 per cent. The per unit value (in a commodity standard) declined 6 per cent. During the period 1923–1929 strikingly different results appear: The value of manufactured goods (in terms of commodities) fell per unit 4 per cent. Labor costs fell 9 per cent and overhead costs plus profits rose 11 per cent.

The other sections of the book are done on an equally elaborate scale. It is not only that the author has discovered new points of attack on the problem of stability, but the statistical material available has been elaborated in a fashion never before equalled. For instance, in the section devoted to the growth of capital, there is the most successful attempt yet made to deal with the almost insuperable difficulties involved.

The author has produced an important book which will long be a source book for those who deal with that instability which is the curse of modern economic society. The National Bureau of Economic Research and the Committee on Recent Economic Changes deserve great credit for making its production possible.

GEORGE E. BARNETT

The Johns Hopkins University

American Business Leaders, Study in Social Origins and Social Stratification, by F. W. Taussig and C. S. Joslyn. New York: The Macmillan Company. 1932. xiv, 319 pp.

The authors of this study have collected new evidences regarding the social origins of American business leaders. They defined business leaders as the partners or owners or higher executives of businesses having for the most part a volume of sales or gross income exceeding $500,000. They took reasonable pains to obtain an adequate sample of this class. They drew up a fairly skilful questionnaire (it could, we shall see, have been improved upon) and they got a surprisingly large response—8,749 replies out of a maximum of 15,101. They set up a competent statistical technique to deal with the resulting materials. And they found, among other things, that 36 per cent of the sample are the sons of fathers who belong to the same general category of "big" business men, that 56.7 per cent "are the sons of business men of one kind or another," while only 12.4 per cent are the sons of farmers, 5 per cent of clerks or salesmen, 8 per cent of skilled laborers and 2.2 per cent of unskilled laborers.

So far so good. While the authors regard their results as in conflict with a

prevailing tradition their figures are in accord with various other evidences, though they are more specific and conclusive. If the authors had stopped at this point, they would have added some significant new facts to our knowledge of the social derivation of business leaders. But, alas, these facts were only the starting-point of a more ambitious enquiry in which, strangely enough so far at least as the senior author is concerned, they proved lamentably inexpert. Their further objective was "to throw light, as far as possible, on the relative influence of hereditary and of environmental factors in causing such disparities as may exist between the representation of the several classes among business leaders and their representation in the population at large." (p. 3)

Here they enter with curious innocence into a difficult controversial field. The history of the attempt to discern and evaluate the respective rôles of hereditary and of environmental factors is full of salutary warnings, but the authors either do not know of them or have not taken them to heart. In their questionnaire they endeavor to evaluate environmental factors under four heads, influential connections, financial aid, general schooling, and formal business training. On the first two heads they ask these questions: (1) Were any of your relatives or friends interested, as owners or executives, (a) in the business which you first entered, (b) in your present organization when you entered it; and (2) Did you, during the early stages of your business career, receive substantial aid (not less than $10,000) through the provision of capital from either of the following sources (a) inheritance, (b) relatives or friends? These questions were put on the ground that "the environmental factors regarded as most essential in contributing towards success in business are two: capital and connections." Observe in passing that "the minimum amount of such aid to be considered significant was set at $10,000"! Observe also that, as the authors themselves acknowledge, if the term "friends" includes business acquaintances, probably most business men, appointed to a position of high responsibility, have friends among the owners or executives of the business in question. Only 26.6 of the sample gave, however, an affirmative answer to this part of the question.

As for the results, it transpired that only 11.6 per cent reported "substantial financial aid" from the two sources mentioned, that 35.9 per cent had "influential connections as that term is defined in the questionnaire," that 31.9 per cent were college graduates, and so forth. It also appears that "business leaders in the United States are today being recruited, to a substantially greater extent than was the case thirty or forty years ago, from among the sons of major executives." And then the authors claim that their evidences "strongly suggest, even if they do not prove, that lack of native ability rather than lack of opportunity is primarily responsible for the failure of the lower occupational classes to be as well represented as the higher classes."

This is one of the baldest *non sequiturs* which the reviewer has come across for a long time in any work purporting to be a scientific investigation. The conclusion is in no logical sense a result of their study, but a mere guess, no better than any other in respect of this most intricate and most fascinating problem. Supposing we find that on all counts only a minority of business leaders had the definite advantage of the four environmental factors listed by our authors, what

follows? Do these meager factors sum up the difference between the environment of the "higher classes" and the "lower occupational classes"? Has poverty no other limiting influence and a higher social position no other stimulation in respect of a business career? Lamely, at the very end, the authors admit that there are also imponderable factors which "lie beyond the scope of the quantitative method," but they dismiss them as relatively unimportant in determining the disparities involved. "The social environment of the wage-earning classes in the United States is by no means devoid of influences stimulating the youth to a life of achievement." "What is more, the way to success in business is made relatively easy for the American boy born of poor parents." Here the authors pull themselves up and add a footnote: "easy, that is, relative to the obstacles which must be overcome by a boy in Europe, born of parents in similar circumstances." Which, of course, has nothing to do with the case. And after a few remarks of similar tenor they blithely restate the "strong suggestion" to which "their results" point, that "inequality of earnings between the several occupational classes has its origins in a fundamental inequality of native endowments, rather than in an inequality of opportunities."

It should perhaps be noted that, while the date of the sending out of the questionnaires is not given, there is internal evidence that it was before 1929.

R. M. MacIver

Columbia University

International Unemployment, M. L. Fledderus, Editor. The Hague and New York: International Industrial Relations Institute. 1932. 496 pp.

This is the first of two volumes presenting reports made to the World Social Economic Congress, held under the auspices of the International Industrial Relations Association in August, 1931. This volume considers data with regard to unemployment in eight nations. The second will include an analysis of factors underlying world-wide unemployment together with conference discussions on World Social and Economic Planning.

The purpose of these investigations and reports is clearly described in an "Introduction and Summary" by Mary van Kleek. They were undertaken to "give a picture of the recurrence of unemployment in different parts of the world during the two decades that have ended in the present depression," to note any evidences of international interrelationships affecting such conditions and to discover the major causes of unemployment in each nation. It is hoped that these studies may occasion more extensive and intensive investigations of a similar nature.

Data relating to (1) fluctuations in employment in each nation from 1910 to 1930, (2) changes in real wages and in living standards during the same period, and (3) related developments in economic resources and changed industrial productivity make up the major materials of these reports. The studies sought to discover particularly the dates of high and low points in unemployment, rather than detailed data as to the extent of these fluctuations in each nation, for it was recognized that international comparisons could be made only in the most general

terms, due to differences in the nature of statistics obtainable in the various nations.

Only brief attention can be given to the most notable contributions of each of the individual national surveys. Several of them are seriously limited by the fact that data for certain years are inaccurate or non-existent. The principal findings of the studies in each of the eight nations may, however, be summarized as follows:

Australia showed little unemployment in the years just preceding the World War. In the last quarter of 1914 and the first quarter of 1915, there was, however, more serious unemployment. During the remaining war years, employment was good, and in the boom years, 1919 and 1920, it improved further. In 1921, unemployment again became serious, but it was reduced immediately thereafter, and, excepting for a bad fourth quarter in 1924, it remained close to its pre-war average until 1928. Since that time it has become increasingly serious. Most important among the causes of unemployment in Australia is the economic distress of those nations that ordinarily purchase greatest quantities of her agricultural products, but importance attaches also to the difficulty of adjusting wage rates to lower commodity prices.

Employment conditions in Australia show a rather close correspondence to those featuring Great Britain. In the latter nation, unemployment was on the decline in the years 1910 to 1913. It was insignificant during the War. In 1919, post-war deflation began, and indices of unemployment rose rapidly as the severe depression of 1921–1922 appeared. Thereafter, until 1930, the percentages were generally somewhat lower, but they established a new and higher level of unemployment, compared to that of the pre-war period. In 1930 a new high record for unemployment was established.

Careful analysis of the industrial, geographic, sex, and age distributions of unemployment in England accompanies this statement of trends, and special attention is given to causes of post-war British unemployment. Particular responsibility attaches, in this connection, to the rigidity of wage rates enforced since the War.

France is distinctive, among the nations studied, for the almost total absence of unemployment in most of the post-war period up to 1930. Directly following the War and until 1923, the difficulty of finding jobs for veterans occasioned some unemployment, but cyclical fluctuations noted in England and Australia did not exert as great influence in France. The years 1923 to the end of 1930, with the exception of one year, 1927, represent a period with almost no unemployment, and, although numbers out of work increased in 1928 and 1929, they have not become comparable to those in England or Germany. Detailed consideration is given, in the study, to characteristics of France that assist in explaining this distinction, and particular significance is attached to the prevalence of reconstruction activities, to flexibility in wage rates, and to the monetary policy of the French government.

Data available in China do not permit a study of conditions in that nation that is at all comparable to those undertaken in the other seven countries. The analysis of "Industry and Labor in China" is actually a brief history of Chinese

industrial development and accompanying legislation. As such it is most interesting and valuable, but the propriety of its inclusion in this volume appears questionable.

The course of unemployment in Germany is somewhat similar to that noted in England. In pre-war years, the nation experienced rather drastic seasonal fluctuations, but cyclical unemployment was not extensive. Although large numbers were out of work in the first year of the War, unemployment during the remainder of the period was slight. After the War, from 1918 to 1923, unemployment remained insignificant, largely because of the industrial activity occasioned by currency inflation. When currency was stabilized in 1924, this situation changed, and 1924 was a year of unusual unemployment. This was followed, however, by a return to pre-war levels in 1925, largely because of the Dawes Plan. In the latter portion of 1925 and in 1926, unemployment again rose. In 1927, however, it was reduced, by the stimulation of business resulting from foreign loans, to the lowest point in the post-war period. Thereafter, in 1928 and 1929, unemployment increased. In 1930 and 1931 it remained at a high level.

Lack of capital, reflected in very high interest rates, appears to have been most important among the causes of German unemployment in this period.

Canadian data with respect to unemployment, like those of the United States, must be drawn largely from trade union statistics, but such data are probably more accurate in the Dominion and they cover a longer time period. They present a sample, also, that has often included 70 to 80 per cent of all organized workers. Unemployment was not serious in the years just preceding the depression of 1914 in Canada, and although it increased in 1914 and 1915, it was slight in the following years from 1916 to 1918. It rose in 1919 and the second half of 1920 and remained high throughout 1921. It fell in 1922 and 1923, rose in 1924, and then fell to very low levels until 1929. It rose rapidly in 1929 and continued this rise throughout 1930. Causes of unemployment appear to be similar to those noted in Australia, although labor conditions were less important in Canada.

In the discussion of employment conditions in the United States, data indicating long-time changes are restricted to factory and railroad workers. Short-time comparisons are made upon the basis of samples secured in recent years. From these data it appears that maximum industrial employment was reached in 1918, and that there was increasing unemployment throughout 1921, 1922, and 1923. Thereafter, until 1929, employment conditions improved, but they did not reach the 1918 level. Unemployment increased rapidly after October, 1929, and had not been reduced at the time this study was completed. Little attention is given to the relative importance of various causes of unemployment.

The section given over to Employment and Unemployment in Pre-War and Soviet Russia indicates that industrial employment declined rapidly in Russia from 1913 to 1923–1924, although unemployment appears to have attracted little attention and to have escaped tabulation until it rose, in 1923–1924, to more than a million. It remained at about that level until 1929, when it almost doubled. Thereafter, a striking decrease in unemployment is noted throughout

the year 1930. The study closes with the observation that practically the only remaining unemployment is that of young people seeking to begin work and adults desiring to shift vocations. Unemployment insurance funds are now being used to adapt these applicants for places in the industrial system, rather than for the payment of insurance benefits, for the latter have become unnecessary.

Meanwhile, production and worker productivity have been greatly increased, and average real wages have risen markedly.

Two conclusions are expressed in the summary. The studies show that unemployment is, in a considerable measure, an international phenomenon, both in its causes and in its effects. Close correlation in employment fluctuations is discernible among nations having important trade relationships. It is suggested that these investigations indicate further that nationalism and fear for national security, by preventing effective economic coöperation, are most responsible for the disturbance of that equilibrium in production essential to general prosperity and minimum unemployment in all nations.

The volume represents much careful work. It is of real value as a reference, and encourages expectant anticipation of its companion study on economic planning. It indicates emphatically the present poverty of inclusive employment statistics and the necessity for more careful collection and analysis of such data.

DALE YODER

State University of Iowa

Agricultural Russia and the Wheat Problem, by Vladimir P. Timoshenko. Stanford University, California: Published jointly by the Food Research Institute and the Committee of the Hoover War Library. 1932. 476 pp.

This volume is of great importance not only to those who are interested in economic conditions in Soviet Russia, but as well to economists and statisticians who have to deal with the problem of world demand and supply of wheat. In most current estimates of the international statistical position of wheat it is customary to refer to world production "exclusive of Russia." In large measure this has been due to the reluctance of statisticians to essay the task of interpreting Soviet statistics. All specialists in this field have wondered whether or not the pre-war statistics of grain production and of sown area are comparable with those compiled by Soviet statisticians at the present time. Dr. Timoshenko has performed the service of analyzing the data and comes to the conclusion that Soviet statistics of grain production are comparable with pre-war statistics only if the pre-war estimates are increased by 19 per cent. He believes, however, that the pre-war statistics did not underestimate crop production and that consequently Soviet statistics must overestimate grain production.

Timoshenko's book is a mine of information in respect to all aspects and details of Russian agriculture, but his particular purpose is to analyze the probable future of Russian wheat exports. He disposes of the popular legend about the unlimited expansibility of crop area by explaining the limitations of temperature

and rainfall which render such a large proportion of the area of Russia unfit for cultivation. He explains that the areas which are suitable for cultivation are already well populated and calls attention to the rate of increase in population which reduces the possibilities for grain exports. He estimates that in order to provide the same per capita consumption of bread grains as during pre-war times and to reach the pre-war level of exports it would be necessary to increase the present sown area by some twenty per cent and to provide an additional two per cent yearly increase in production to take care of further population increase. He does not believe, therefore, that the resumption of grain exports upon the pre-war scale is to be counted upon under existing circumstances.

CALVIN B. HOOVER

Duke University

The Fiscal Problem in Massachusetts. New York: National Industrial Conference Board. 1931. xv, 344 pp.

This study aims at an objective description of the state and local system of revenues and expenditures in Massachusetts. The preface disavows any intention of recommending or advocating specific proposals, but this attitude does not prevent some fairly definite expressions of preference in a chapter dealing with possible adjustments in the revenue system.

As a purely descriptive undertaking, the result is fairly satisfactory; but it is subject to the shortcomings necessarily incurred by such a self-imposed limitation of scope. The Conference Board apparently refrains from demanding of its staff the insight, judgment and wisdom that would be required to infuse vitality and meaning into its compilations of data. Consequently the result does not rise above the level of a handbook or compendium of information regarding state and local finances in Massachusetts.

The opening chapter, on state and local expenditures, illustrates the point. It is a useful compilation of expenditure data and trends for the state, the counties, and the cities and towns. This task was relatively easy for Massachusetts, and the results were the more reliable, on account of the comprehensive annual statistical reports on local finances issued by the state.

It is unfortunate that even so much of comparative analysis of such data as is given here had to wait for an outside agency. The reviewer has long held that governmental statisticians have not yet learned the A B C of proper statistical use. The enormous possibilities of informing and educating the people as to what government is and does are almost wholly neglected in official reports. Professional statisticians could achieve no greater triumph than that of inaugurating a movement to cut the dust out of government statistics and make them the basis of a vital, human story of governmental business.

The chapter on expenditures in this study lacks the divine spark. It is designed as a keynote to the whole undertaking. It goes through the motions of explaining why taxes have increased and why Massachusetts has a problem of fiscal readjustment, but after all the careful tabulation of the facts, it emerges from the self-same door wherein it went—public expenditures have increased.

There is no recognition of the vital problem of functional allocation. County expenditures are tabulated, but the possibilities of the county as an administrative unit are not considered. The county is traditionally weak in Massachusetts. What of it? When backs are breaking under tax burdens, there is need of a courageous examination of every possibility that may secure lower costs. The devotees of the baked bean, the cod and the town meeting may not like the answer, but some one needs to find out for Massachusetts, where the several governmental functions can best be performed. The important experiment with metropolitan districts in Massachusetts is not touched upon, although it affords opportunity for an immensely important contribution to the fundamental problem of administrative efficiency.

The chapters dealing with the revenue system cover well-known ground, without contributing to what was already known of the situation. A final chapter indicates that expenditure control is essential, but goes no further than brief reference to the schemes operating in Indiana and North Carolina. The control of expenditures is the heart of the fiscal problem, in Massachusetts and every other state, but this control involves matters of administrative organization and financial policy that are not dealt with at all in this study.

H. L. Lutz

Princeton University

Balances of Payments, 1930 (including an Analysis of Capital Movements in 1931). Geneva: Publications Department of the League of Nations. 1932. 183 pp.

This is Volume II of an annual series of publications by the League. Volumes I and III are, respectively, "Review of World Trade, 1930" and "International Trade Statistics, 1930." It is of special value to Americans, because the United States Department of Commerce regularly issues, at lower prices, virtually all the data contained in Volumes I and III; whereas no other serial publication in the world summarizes the balances of international payments of all countries compiling them. The publication is obtainable at the World Peace Foundation, 40 Mt. Vernon Street, Boston, Massachusetts.

This latest annual issue contains further striking evidence of the rapidly growing interest in balances of international payments, the world over. It summarizes the surveys of no less than 32 countries. The corresponding publication by the League for 1923 covered only 10 countries. Going back a decade earlier, I am fond of the confession that—after majoring in the theory of international trade during two years of graduate work at Columbia University—I escaped as oblivious to the existence of this statistical species as was Adam Smith. The term "balance of payments" had been used as early as 1819, as Miss Cleona Lewis proves in her treatise on the International Accounts; yet, as late as 1914, one would philosophize profoundly about the relationship of visibles and invisibles in foreign trade without realizing that anyone "had a name for it."

The present compendium brings into the fold such welcome strangers as Albania, Bulgaria, Paraguay and New Zealand. Presumably their balances of payments will appear annually hereafter, in steadily improving detail and pre-

cision. Surinam, Dutch East Indies, and the Irish Free State are among countries previously reporting. Curiously enough, only a few of the ten foremost trading or lending nations have thus far compiled their balances of payments with such scholarly method as certain relatively small nations like Hungary, Czechoslovakia and Yugoslavia. France, for example, issues no official balance of payments at all. England still clings to its antiquarian, "two-cylinder" report, which sometimes goes to press a fortnight or so after the year-end. Yet, it is from this British prototype that all the others have been evolved during the past two decades.

The League always presents balances of payments in a standardized "account" form, rather than in varying "report" forms. That I have always regarded as a defect. In account form, they make duller reading. Besides, their uniformity suggests a degree of comparability that does not exist. The standardized form seems too inelastic to fit the varying conditions and problems of all countries, and it impedes progress in presentation. Premature standardization, in a pioneer field like this, might well have been avoided.

This League publication, together with others of its series, greatly facilitates a study of business cycles from what is relatively a new angle. In our last world depression (approximately 1919 to 1921) data hardly existed for a separate study of the international aspects of the cycle. A sturdy beginning of such a study, of the present world depression, is contained in the 36 pages devoted to "A Summary Statement Concerning Certain Items." I refer especially to the admirable discussions on:

(a) Capital balance and its relation to merchandise and gold movements.
(b) Capital movements and relative prices.
(c) United States capital and gold movement.
(d) Long- and short-term capital operations in 1930 and 1931.

Nowhere, I think, is there a more succinct story of how world business was thrown out of gear by the reckless inflation and ruthless deflation of the capital-importing nations by capital-exporting nations. America's large share of responsibility for that masterpiece of destructiveness, by the way, is too often denied.

The compendium gives, perhaps properly, more space to the balances of payments of America, England and Germany than to most of the others. The American survey, as published by the Department of Commerce, is still the richest source-book in methodology, being 40,000 to 50,000 words long. In summarizing that publication, the League neglected to point out that the net export of capital by the United States in 1930 was estimated by a different method and hence is not comparable with the figures for earlier years. That much of the public controversy in this country, over our 1930 balance of payments, could have been mentioned by the League editors, without taking sides in a dispute that still rages.

RAY OVID HALL

The Banking Situation in the United States. New York: National Industrial Conference Board. 1932. xiv, 157 pp.

This study, prepared by Ralph A. Young and assistants, will be extremely useful both to business men and to teachers. It is the only volume published to date which undertakes to bring together in brief compass all the main statistical facts in the history of the American banking system since the War. This task it performs well. The main lines of the exposition are intelligently organized, and the reader is left with as compact a picture as the subject matter itself will permit.

The principal facts and changes with which the book deals are already familiar to students in the field. They are, in chief, the remarkable post-war growth of deposits; the persistent shift of deposits from the demand to the time category, with its resulting decrease in aggregate effective reserve requirements and increase in the vulnerability of the banking system to initial shocks; the changing structure of the system itself, due to failures, mergers, and the growth of branches and chains; the shift in the character of bank assets, with a falling proportion of commercial documents and other commercial claims and a rising proportion of securities and mortgages; the change in the character of business requirements for bank credit which this shift reflects; the inability of access to Federal Reserve system resources to prevent, in itself alone, appallingly numerous bank failures; and the drastic readjustments in the structure of American bank credit as a whole which severe business depression, under these conditions, has almost inevitably produced. The principal facts under these heads are brought out clearly. The general reliance on percentages to indicate the importance of changes, rather than on logarithmic charts, does not here introduce serious distortions (unless in connection with surplus reserves, as on page 130). The critic may cavil somewhat at the discussions and tests of "liquidity," or at least desire that the analysis had been pushed farther (pp. 76–81, 94 ff., 105, 108, 125 ff.) but the matter is not vital to the general purposes of the book.

The discussions of the real meaning of what has taken place, however, and of what should be done to strengthen the banking system in the future, is rather less satisfactory. It is suggested that the unification of legislative and administrative control under the Federal Government is desirable, and also an expansion of the branch and chain systems—this last, of course, in order to reduce the number of small, inefficient, weak unit banks. With these suggestions we may agree. But to the present reviewer, it does not seem that such proposals go to the heart of the matter. The great fact about our banking system which the present depression has revealed is that, to a degree we have never before equalled, we have had far too much banking, and far too large a volume of bank deposits. In the face of what we now see to have been such marked over-expansion, it may be doubted if any banking system at all could have remained unimpaired, or perhaps even solvent; in the face of such over-expansion, the traditional canons of "liquidity" and "shiftability"—which themselves are only relative at best—may become almost valueless as guides to practical banking policy. The power to create additional bank deposits, additional media of exchange, is one of the

most potentially dangerous powers in the economic world. It is this power, now restricted only in terms of the maintenance of minimum reserve ratios, which itself supremely requires to be guarded and controlled in absolute terms as well. Until such control is secured, no forms of legal and operative organization can assuredly safeguard the banking system and the country's general economic life.

JAMES W. ANGELL

Columbia University

Die Wirtschaftlichen Zeitreihen als Problem der Korrelationsrechnung, by Herman v. Schelling. Veröffentlichungen der Frankfurter Gesellschaft für Konjunkturforschung, herausgegeben von Dr. Eugen Altschul. Heft 11. Bonn: Verlag von Kurt Schroeder. 1931. 64 pp.

The Frankfurter Society for the study of conjuncture continues its series of interesting publications on the problems of the analysis of time series, particularly of their correlation. In one of the previous issues (Heft 4, *Die Korrelationsrechnung in der Konjunkturforschung*) Oskar Anderson developed a complete theory of the variate-difference-method. In the present publication, v. Schelling considers time series correlation with special reference to the "lag" problem, basing his analysis on the earlier study by Anderson. He shares with Anderson his scepticism of the method of breaking down time series into their component elements—such as trend, seasonal fluctuations and cycles—so popular in this country. He thinks that the different ways of eliminating a trend (particularly by some form of mathematical curve) may so affect the measure of correlation that it is hardly possible to have much confidence in it. The author holds that there is no strict measure of correlation of general significance (allgemeingültig) for any empirical data. He qualifies his scepticism, however, by pointing out that when empirical data are duly arranged and several or many coefficients of correlation, comparable one with another, are obtained, conclusions may be drawn from their relative values.

In developing his positive contributions, the author emphasizes the necessity of computing many coefficients of correlation, shifting the two series one along the other, and analyzing the relative values of all such coefficients. The totality of these coefficients rather than the separate coefficients is indicative of the degree of association. He tries to show (in a mathematical appendix) that while the absolute values of the coefficients may be substantially affected by an incorrect breakdown of the variables into their component elements (for instance by an incorrect determination of the trend values) and for this reason the individual coefficients cannot be relied upon as a measure of association, the *relative* values of several coefficients calculated for two series shifted one along the other, retain, under certain conditions, their true proportions and are comparable. An analysis of the relative values of several such coefficients is thus used not only for determining the time "lag," which is a general practice, but also for determining the "direction" of the relationship: which of the two factors may be considered as a cause and which as a consequence, whether there is a mutual influence of factors one upon another, and what is their relative importance. Although

sceptical of the possibility of extrapolating time series in general, v. Schelling indicates a procedure by which such extrapolation for a short period may be done with some degree of reliability, using for this purpose, a detailed study of serial correlations (using the term of Yule).

To reduce the amount of computation v. Schelling develops, in the third chapter, graphic methods for determining the coefficient of correlation, especially adapted to the correlation of series shifted one along the other. He claims that his method requires much simpler and cheaper implements than the automatic correlation calculating machine of C. L. Hull.

The problem studied by v. Schelling is of great importance. In the correlation of time series on the relationship between crop prices and yields (or total production) it has proved to be most valuable to have several coefficients computed from the series of prices and of yields shifted one along the other. For this a theoretical analysis of the problem in a general form is welcome. It is only to be regretted that v. Schelling's analysis is sometimes sketchy and not always clear. The fact that mathematical proofs are removed to mathematical appendix does not make the reading of the text easy for persons not specially trained in mathematics. An illustration of the method by solution of a few concrete problems would facilitate the reader's understanding.

V. P. Timoshenko

University of Michigan

Review of World Production, 1925–1931. Geneva: League of Nations, Economic and Financial Organization. 1932. 166 pp. (American Agent, World Peace Foundation, Boston, Massachusetts.)

In the latest review of world production by the League's Economic and Financial Section more attention is given than in earlier issues to the course of industrial production and of prices, with particular emphasis on the varying severity of the depression of 1930–1931 on different continents and in different industries. A significant new feature is an analysis of the incidence of price declines on consumers' as opposed to producers' goods and on industrial as opposed to agricultural raw materials. The period covered in this edition—1925 to 1931—offers a contrast between the expansion of production in the years 1925–1929 and the depression of the years 1930–1931, and is an invaluable background for observation of current economic developments. The *Review* gains in perspective what it loses in timeliness by reason of the fact that the data on which the studies are based are with few exceptions annual rather than monthly, and the most recent figures are for 1931.

The methods used in constructing the indices presented in the *Memorandum* have not been altered materially from those established in earlier editions. The base period has again been shifted, this time to the average for the period 1925–1929, and while the advantages of the quinquennium as compared with a single-year base are obvious, one wishes that the base period might remain unchanged for at least two years in succession for the benefit of those who make considerable

use of the indices, and who find it inconvenient annually to revise both their memories and their charts.

ARYNESS JOY

Division of Research and Statistics,
Federal Reserve Board

Disability Benefits in Life Insurance Policies, by Arthur Hunter and James T. Phillips. New York: The Actuarial Society of America. 1932. ix, 252 pp.

Restricted disability benefits were introduced into life insurance contracts in the United States in 1906. The competitive value of such benefits led to their adoption by most companies, and to the gradual liberalization both of contract provisions and of administrative interpretation. Premiums have proved inadequate, and the companies, involved in serious loss on account of this business, have now reversed their attitude. Disability clauses have been either discontinued or restricted, and where continued have been much less freely issued.

The appearance of the present volume is most timely. The authors, one of whom, Dr. Hunter, has been closely identified with the development of this business from its inception, have brought together the essential information on the history and present status of the problem.

Part I is devoted to the development of disability benefits and to the business and legal problems to which they have given rise. It is a brief text on the principles and practices of this branch of the life insurance business. Part II deals with the statistical and actuarial phases of disability insurance: experience, mortality and disability tables, annuities, premiums, and reserves. It is a complete technical explanation by highly qualified technicians.

In addition to the textual material the Appendices contain a collection of forms, the proposed standard provisions of 1929, definitions of actuarial symbols, and a valuable bibliography.

Whether one's interest in the development of disability benefits be general, technical, or both, this book may be relied upon as an up-to-date authoritative treatment of the subject.

RALPH H. BLANCHARD

Columbia University

The New York Money Market, by Margaret G. Myers. New York: Columbia University Press. 1931. xv, 476 pp.

This is the first volume of a comprehensive study of the New York money market prepared under the auspices of the Council for Research in the Social Sciences of Columbia University. It covers the period from the time of the Revolution to the adoption of the Federal Reserve Act. A subsequent volume by Benjamin H. Beckhart, James G. Smith and William A. Brown will cover the Federal Reserve period to date.

Miss Myers has wisely avoided a narrow monographical treatment. The money market is an interdependent whole and none of its institutions can fruit-

fully be examined in isolation from the complex structure of which it is a part. The author adopts Bagehot's phrase "borrowed funds" as the limiting concept thus including "all the funds available for productive, commercial and speculative purposes, as well as the mechanism by which these funds are gathered from holders not immediately requiring their use, and redistributed in answer to the needs of various classes of borrowers." She avoids the usual disadvantages of the more conventional historical treatment by a happy topical arrangement with summarizing chronological chapters. The review chapters X and XIX can be recommended to those who lack time or interest for the topical treatment.

The money market is obviously not a subject for isolated study. Miss Myers has placed it in a broad framework of national economic and political development, Treasury policies and other related factors. The chapters on foreign credits and the independent treasury are good examples of this and would be much weaker if artificial limitation of subject matter had been preferred. This choice of a more comprehensive treatment is all the more justified since this is the first full historical treatment of the New York money market.

The author has given a competent and very readable account of her subject. The reviewer can vouch for its value as a reference work from his experience with it during the period in which it awaited more systematic attention. The Columbia University Press is to be congratulated for its handsome treatment of both text and illustrations.

HARRY D. GIDEONSE

University of Chicago

Preferred Stocks as Long-Term Investments, by R. G. Rodkey. Ann Arbor: The University of Michigan. 1932. 304 pp.

This study "is concerned primarily with the investment qualities of preferred stocks on an absolute basis. Of secondary importance are the comparisons made herein with bonds and common stocks of identical companies." In the last few years many students have approached the examination of securities with the same viewpoint. But is it possible to determine the investment qualities of stocks or bonds "on an absolute basis"? Qualities are relative, not absolute. The much-used hypothetical-investor tests, which Mr. Rodkey employed, do not reveal the "true nature" of securities. Such calculations show for the past the superiority of one investment plan over another. Their value lies in the fact that an individual with a knowledge of the results, bearing in mind his own requirements, and guessing at the similarity of the future with the past, is able to formulate a more intelligent investment policy.

In each of Mr. Rodkey's tests, equal sums were assumed to have been invested in the common and the preferred stocks, and in some cases the bonds, of ten identical companies. The period covered in most of the calculations was January, 1908, to January, 1932,—two dates of deflated security values. The companies selected were those for which there were recorded the largest volumes of common (in one test, preferred) stock transactions during the year immediately preceding the date of purchase. The common stock investments in every test gave results

superior to the preferred both as to average annual yield and as to capital appreciation. The preferred stocks, however, showed comparatively good results on both of these counts when only those stocks which were not preceded by bonds were held. Furthermore, the market value of these same preferred stocks fluctuated less violently than the common. When preferred stocks were compared with bonds, the average annual income and the capital gain for the twenty-four year period were greater in the case of preferred stocks.

The securities of identical companies were used because "changes in the credit conditions within the various companies presumably would thus find reflection in the prices of all lists." For comparative purposes, additional tests should have been run without this restriction. It is doubtful that an investor weighs the common stock of a company against the preferred of that same concern.

What is the justification for selecting stocks for investment on the basis of the volume of transactions in a certain type of security for a given time interval? Surely such technique does not give a sample chosen at random—and apparently that was wanted. If an effort is to be made to eliminate the factor of human judgment, why not pick the securities by lot? The results of such procedure would be very interesting—particularly, if to random selection for purchase, there was added the sale at regular intervals of one or more securities chosen at random from the investor's portfolio. It is not expected that such tests will reveal the "absolute qualities" of preferred stock or other securities, but the results could be compared with those obtained through various investment plans. Thus we would get some indication of the value of human judgment in investment.

Most investigators who run such tests as those described in this study assume that the hypothetical investor purchases ten securities—either because ten is ten or because an investor can be expected to watch only ten. Mr. Rodkey made an effort to prevent criticism on this point. First, the number of companies with common and preferred stocks, or with common and preferred stocks and bonds, was small in 1907, so that ten formed a large per cent of the whole. But, it might be asked, was the total large enough to yield valuable results? In the second place, Mr. Rodkey protected himself by making some supplementary tests which began with 1921 when selection was not confined to a small number of companies. In these tests substantially the same results were obtained as in those which began with 1908. Other individuals making similar studies would do well to check the size of a sample in some such way—or better, make tests with samples of various sizes.

In view of the small amount of work which has been done upon preferred stock, it seems advisable to consider one of Mr. Rodkey's assumptions, namely, that the conservative low-yield preferred stock is superior to the risky high-yield one. Under certain conditions this may be so, but some supporting data are necessary. An examination of Mr. Rodkey's fifth and sixth tests, which were identical in procedure except for a slight difference in the method of selection, produced some interesting material. The sixth, which showed both a larger average annual income and a larger capital gain, started with the purchase of stocks having an average (median) yield of 9.50 per cent, while the parallel figure for the fifth test

was 8.08 per cent. Among the original preferred stocks of the sixth test there was one upon which nothing had been paid in the year preceding purchase and there were five upon which full dividends had been paid for at least eight years; in the fifth test none of the first type was found and seven of the second appeared. Furthermore, one of the three preferred stocks which were retained throughout Test 6 was purchased at a price which yielded 12.3 per cent and produced a profit of $660.77. In contrast, another, purchased on a 7.7 per cent basis, showed a loss of $712.63. Finally, in the sixth test the maximum capital gain procured from a single original preferred stock purchase was received on the stock which had not paid anything in the year preceding acquisition. Of course, the evidence presented here merely suggests that the high-yield preferred stock cannot be lightly dismissed from consideration.

It seems to me that in valuing this and similar studies, we must remember that they may not—perhaps cannot—reveal the true nature of securities. Conclusions when examined from this viewpoint rarely seem justified by the material presented, though the tests themselves may be interesting and helpful. General statements—such as, preferred stocks which are senior securities fluctuate in market value less than common stocks and thus investment in these tends definitely to minimize the time hazard—should be properly modified. Would it not be possible to take the same or a different period, pick common stocks in one way and preferred in another, and get a contradictory result? If my query is subjected to the criticism: "You would use different periods or different methods for picking the stocks"—my answer is: "Just so. And you by your comment have admitted that this study shows only what particular tests will yield and not the qualities of preferred stock on an absolute basis."

George Heberton Evans, Jr.

The Johns Hopkins University

Recent Technological Changes and the Municipally Owned Power Plant, by Paul Jerome Raver. Chicago: The Institute for Economic Research. 1932. 86 pp.

To five previously published monographs on the historical and legal aspects of public enterprise in the power field, the Institute of Economics, affiliated with Northwestern University, has now added an excellent, though limited, analysis by Professor Paul Jerome Raver of the influence of technological factors upon the number, character, distribution, and fortunes of municipal generating enterprises. Professor Raver's data include every instance of municipal ownership between 1903 and 1930; his treatment, accompanied by unusually complete statistical tables, is lucid and painstakingly fair. After reviewing the rise, mortalities, and survivals of municipal plants in terms of prime movers, generating capacity, and regional differences, Professor Raver concludes that the growing resistance of municipal plants to further absorption by private enterprise is due to the establishment of a competitively successful "plateau of growth," composed of plants of more than 500 horsepower; and he predicts that most of

the remaining municipal plants will continue to grow and will become important keys in regional and national power plans.

The bare statistical facts of the relative growth of public and private enterprise in the electric light and power industry lend themselves easily to biased and contradictory interpretations. Opponents of public ownership are able to point to the fact that by the end of 1930, more than two-thirds of all the municipally owned generating plants that had been in operation at any time since 1903 had been sold to private interests or had substituted the purchase of power from the latter for municipal generation. Supporters of public ownership, on the other hand, are able to say that the installed horsepower capacity under municipal ownership at the end of 1930 was twelve times as great as it had been in 1904, and that more than one-half of this growth has taken place during the last decade. But there has been no real race between public and private capital in the electric power field. The distribution and scope of public ownership have been seriously limited by constitutional and statutory law. Where the law has not effectively barred public enterprise, it has largely restricted it to *municipal* political units operating under fixed constitutional debt-incurring possibilities and under charters that obstruct inter-municipal coöperation. The effects of technological developments upon the character and extent of public enterprise, discussed in the present monograph, are to be attributed in important measure to these legal barriers.

The majority of small municipal plants were started because private initiative was slow in supplying the needs of small communities. When, after 1917, enormous improvements in large-scale generating and transmission equipment encouraged the spread of transmission lines over large areas, hundreds of such plants were sold to private enterprises and abandoned, or were converted into municipally owned distributing stations. This took place not because of any weakness in public ownership as such, but because the small isolated plant, whether publicly or privately owned, could no longer generate electricity as cheaply as it could be delivered over transmission lines from large central stations. Thus, the decrease in the number of privately owned generating plants engaged in the sale of power was just as striking as that of municipal plants: the Census of Electrical Industries (U. S. Bureau of the Census) shows a drop in their numbers from 3,347 to 1,218 between 1917 and 1927 alone, a decrease of approximately 64 per cent. *Small* isolated plants, both publicly and privately owned, are still fairly numerous, but they are to be found chiefly in communities distant from transmission lines, or, as in the Southwest, where oil engines may tap a cheap source of power.

Wherever municipal operation has been conducted in communities large enough to employ large-scale steam turbine or hydro-electric equipment, it appears to have thrived vigorously and to have shown little tendency to surrender to private enterprise. Of the twelve-fold expansion in municipal generating capacity between 1904 and 1930, 85.5 per cent was the result of internal growth; and in the period of most rapid expansion, 1922 to 1930, the largest plants grew most, the 20 largest contributing 45 per cent of the aggregate internal growth. Despite the large *number* of plants deserting the municipal fold, the resultant *gross* loss in generating capacity was only 13.5 per cent of the accumulated total

generating capacity under municipal ownership at any time between 1904 and 1930.

These facts indicate that public enterprise in the power field has proved practicable on a municipal scale in communities large enough to employ modern generating apparatus. They do not, by themselves, throw light on the relative merits of public versus private ownership. The ability of moderate- and large-sized municipal establishments to compete successfully with interconnected generating and transmission systems of private enterprise may be matched by the similar success of isolated privately owned plants operating under similar conditions. The explanation in both cases is the same.

Transmission systems are load-gathering devices that make possible larger-scale generation and its economies. The range of such economies is not unlimited, however; and this range is narrowed, in effect, after generating efficiency has reached a certain point, by the line losses, maintenance expense, and capital charges of extensive transmission systems. Isolated plants operating in densely populated or great power-using industrial regions may achieve high generating efficiency without the burdens of extensive transmission lines.

The deficiencies of Professor Raver's study relate chiefly to its restricted character. No attempt is made to translate technological considerations into terms of pecuniary costs and pecuniary returns. No measure is given of the differences in rates that induced many communities to abandon municipal generation of power; of the comparative costs and rates of public and private enterprises employing the same or different types and sizes of generating equipment; the question of managerial competence is barely mentioned. The final facts of mortalities, survivals, and growth, which have been significantly influenced by various other factors, are thus elliptically correlated with qualitative technological considerations.

Like the preceding studies of the Institute, the present monograph is designed to provide indisputable factual material for use in the controversy between advocates of public and private enterprise (cf. Preface). Within its rather severely restricted scope, it does this in excellent fashion. To impinge upon some of the really crucial issues, however, it needs to be generously supplemented by studies in terms of costs, rates, and service; including, particularly, an important group of case studies of the capital costs, operating costs, and rates of comparable public and private enterprises.

LAWRENCE H. SELTZER

College of the City of Detroit

INTERNATIONAL LABOR OFFICE

Geneva, Switzerland

MEMBERS of the *American Statistical Association* and other social science groups are cordially invited to write to the **WASHINGTON BRANCH, INTERNATIONAL LABOR OFFICE, 734 JACKSON PLACE, WASHINGTON, D. C.** for information concerning any phase of I.L.O. work, or for a Catalogue of Publications. A list of the regular publications of the Office is given below:

1. **INTERNATIONAL LABOR REVIEW** (*Monthly*).
Articles on industrial affairs, wage and unemployment statistics, etc.
Price: per no., 60 cents; per year $6.00

2. **INDUSTRIAL AND LABOR INFORMATION** (*Weekly*).
Current events affecting industry and labor, immigration and the work of the International Labor Organization.
Price: per no., 15 cents; per year $7.50

3. **OFFICIAL BULLETIN** (*At irregular intervals*).
Official information on matters connected with the life and work of the International Labor Organization.
Annual subscription $1.00

4. **LEGISLATIVE SERIES** (Trilingual) (*Annual*).
Reprints and translations of laws and regulations affecting labor in different countries.
Annual subscription (volume or advance prints) $8.75
Annual subscription (both) $15.00

5. **INTERNATIONAL SURVEY OF LEGAL DECISIONS ON LABOR LAW** (*Annual*).
Price $2.00

6. **INDUSTRIAL SAFETY SURVEY** (*Bi-monthly*).
A link between those in all countries interested in accident prevention.
Price: per no., 30 cents; per year $1.50

7. **DOCUMENTS OF THE INTERNATIONAL LABOR CONFERENCE** (*Annual*).
The Questionnaires and Reports issued for the Conference, the Director's Report, the Final Record of each Session and the texts of the Draft Conventions and Recommendations adopted.
Annual subscription $10.00

8. **BIBLIOGRAPHY OF INDUSTRIAL HYGIENE** (Trilingual) (*Quarterly*).
Price: per no., 30 cents; per year $1.00

9. **I.L.O. YEAR BOOK** (*Annual*).
Survey of Social and Economic Movements and Labor Legislation.
Paper bound $3.00
Cloth bound $4.00

10. **STUDIES AND REPORTS.**
Monographs on various labor problems, e.g., *Statistics, Immigration, Unemployment, Wages & Hours, Industrial Hygiene, Industrial Organization, Cost of Living, etc.*
Annual subscription $10.00

11. **ENCYCLOPEDIA OF INDUSTRIAL HYGIENE.**
Information concerning unhealthful industries or processes.
Price: (1) Brochure edition $16.00
(2) Volume edition $16.00
(3) Brochure and volume edition $20.00

12. **INTERNATIONAL LABOR DIRECTORY.**
Guide to industrial organizations, both official and unofficial.
Price $3.25

The *Encyclopedia of Industrial Hygiene* (11) and the *International Labor Directory* (12) are "Special Reports." Any brochures of the former and any parts of the latter published during the period covered by the subscription are included in the all-inclusive subscription price, which is $40. All prices and rates are postpaid.

RUMFORD PRESS
CONCORD, N. H.

APR - 7 1933